DESIGN RECORD

CANADIAN-DEVELOPED MILITARY VEHICLES WORLD WAR II

VOLUME I

GENERAL (INCLUDING INDEX)

ISSUED BY
Army Engineering Design Branch
Department Of Munitions And Supply
Ottawa, Canada

GENERAL
(INCLUDING INDEX)

RESTRICTED

DESIGN RECORD CANADIAN DEVELOPED MILITARY VEHICLES WORLD WAR II

VOLUME Nº I
OF 8 VOLUMES

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BY

ARMY ENGINEERING DESIGN BRANCH
DEPARTMENT OF MUNITIONS & SUPPLY
OTTAWA CANADA

DEC. 31ST 1945

AN APPRECIATION

Canada has been credited with having made an outstanding contribution in her provision of military vehicles.

As part of this design development history, it is only fitting to record that this achievement resulted from the wholehearted co-operation of a large number of individuals. It is true that Canada's automotive industry was well equipped physically; but it is equally true that these physical assets would not have been used to the same advantage had not a spirit of all-out-effort prevailed.

The Army Engineering Design Branch, placed as it was at a focal point of development, had a unique opportunity of witnessing the contribution provided by individuals and groups. It is with a keen appreciation of the facts that this Branch pays tribute to both the Users and to Industry for the efforts put forth and to the honesty of purpose which was displayed.

The Users placed their design demands in our hands in a way that permitted Industry to use its best judgment and initiative within the limits of the contenplated use of the vehicle. For the sake of the overall programme they often accepted compromises which must have been "hard to take". The understanding, displayed by the troops in the Field, toward design shortcomings spurred the designers to improve in a way that nothing else could have done.

The men of industry buried inter-company rivalry and co-operated in long hours of effort. Many times the requirements in the Field changed just when a new design was ready for release. Nothing could have been more disheartening but the vocal expression of the disappointment was usually restricted to one choice word. How well these men did their job needs no elaboration here as the vehicles themselves represent the most authentic testimony.

The personnel of Army Engineering Design Branch count it a privilege to have had the opportunity of working with capable people who so wholeheartedly subordinated self interest to a common effort.

FOREWORD

During World War II, Canada produced upwards of 900,000 vehicles for military users. These ranged in type all the way from modified conventional commercial trucks to tanks.

Obviously, a great deal of experience was gained as a result. Lessons were learned which applied to design, production, operation and maintenance. What value this experience may be for the immediate and the extended future cannot be foreseen at present; but it does not appear right to throw it away lightly.

Voluminous quantities of records were accumulated during the development, manufacture and use of these vehicles. Those, which are considered of any possible future value, are being retained. However, the quantity of correspondence, specifications, drawings and so forth is so great that it is questionable whether full use could be made of them without some key. Furthermore, it would be very difficult for anyone, other than those who were directly involved, to make a proper summary of that intangible item "experience gained".

The Army Engineering Design Branch of the Department of Munitions and Supply was charged with the responsibility of obtaining or creating the design for these vehicles. In order to provide a key to the mass of design records and in order to record experience gained, this Branch is issuing a "Vehicle Development Record" of which this is Volume I.

The complete "Vehicle Development Record" consists of eight volumes,

Volume	I	- General (Including Index),
	II	- Armoured Vehicles (other than tanks),
	III	- Tanks and Tank Type Vehicles,
	IV	- Self Propelled MT Chassis,
	V	- Bodies and Non-Technical Vehicles,
	VI	- Technical Vehicles,
	VII	- Trailers,
	VIII	- Mud and Snow Vehicles.

Volume I deals with items of a general nature, but the remaining seven volumes refer to specific classes of vehicles or components. Each of the latter volumes are further subdivided. In this manner, it has been possible to write a history of the development of each class of vehicle and to provide an illustrated data sheet for every individual vehicle which was not definitely obsoleted.

In writing the various "histories of development", a sincere effort has been made to be factual. Any <u>suggestions</u> for future consideration or any <u>opinions</u> given are clearly identified as such. It will be noted that discussion of design failures or weaknesses is not avoided. This is done so that the future designer may save time by avoiding some of the errors that were made during the war. In fact, it is EXPERIENCE, both good and bad, that is recorded.

An index, applicable to all eight volumes, may be found in the final pages of Volume I.

Reference is made in these books to the places where more detailed information may be found. Each page which describes an individual vehicle gives a list of such references. Similar information is given throughout the historical text.

It is not intended that these books should be of use to the designer only. They are intended to form a general master reference which gives a broad description and which also provides the key references for the location of more detailed information. Thus, they should be of value to anyone, as a starting point for inquiry or study.

December 31st, 1945.

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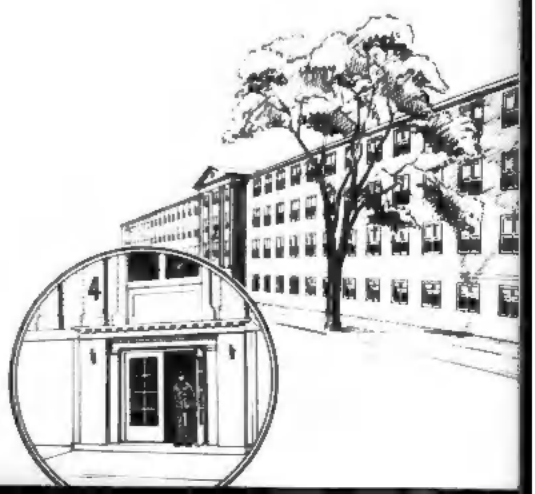


DESIGN DEVELOPMENT

At the outbreak of war no true military design was available which had been adapted to Canadian production facilities. The Department of National Defence was not in a position to instruct industry to tool up for any prepared design. The tooling and a great deal of the preparation for machinery and plant layout had to wait upon the development of design.

The policy was laid down that Canadian Army vehicle design should be based upon that of the British Army.

The major Canadian automotive plants were each related to a larger organization in the United States and the basic design of the chief components originated in the U.S. For this reason, it would have been a more normal procedure, from a strictly production standpoint, for Canada to have based her design on that of the U.S. Army. However, the United States had not entered the war, and as Canada was to fight as a partner of the U.K., it was natural that she should build to the British Army standards. It was not realized in 1939 and early 1940 what a large volume of vehicles was to be built by Canada in the succeeding war years.

Designs of typical British vehicles were obtained and Canadian-made components were adapted to such designs as closely as possible. The major components, such as engines, determined the class of vehicles which were to be manufactured in this country.

The engines being manufactured in Canada at the time were the Ford, Chevrolet and Dodge. These in relationship to U.K. design were suitable for trucks ranging from 8 cwt. to 3 tons.

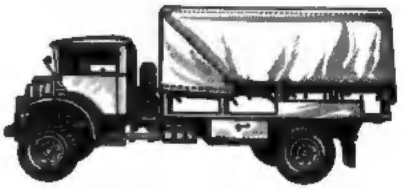
The Ford Motor Company of Canada and General Motors of Canada were approached by the Department of National Defence and were asked to co-operate in developing a line of military vehicles to British standards. Each company was to manufacture such vehicles but the design was to call for as many common or interchangeable parts as possible. These two companies responded in a most satisfactory manner. Their normal intense rivalry was dropped and they worked together as a team. Each used its own power plant, chassis frame and cooling system. From that point on, they sought interchangeability within the limitations imposed by these components.

This interchangeability or standardization was achieved in the case of many components, but it was far from being complete and it actually decreased during the war.

As a result of lack of design, design engineers were placed under tremendous pressure. Speed was all-important. Certain functions, such as front-wheel-drive and transfer cases, were unfamiliar to Canadian designers. Although expert advice was sought in Canada, the United States, and the United Kingdom, the decisions had to be made quickly without the desired amount of study. Testing could not be done until pilots had been made. In the meantime, long chances had to be taken in order that material might be ordered and tooling started. Engineers, who were accustomed to taking three years development time plus endless miles of testing, before releasing a model, were called upon to make virtually snap decisions.

As pilots were rushed through, testing became possible. Certain weaknesses were found, as might be expected under the circumstances. Those weaknesses which it was feared would seriously affect performance or life of the vehicle, resulted in re-design and retooling. These revisions caused delay, but not as much delay as if all components had been held back for complete proving. It was an expensive way to design but, under the emergent circumstances, it was the best because it was the quickest. While the outstanding points of criticism were corrected, as mentioned above, certain basic designs were released at the beginning which have continued as deterrents to improvement throughout the war; for it must be understood that the industry bent every last facility toward production and thus a pause to change tooling or layout for new design was often next to impossible.

The combination of Ford-General Motors trucks was first known as the "D.N.D. Pattern" but later, when orders other than the Canadian Army began to order in large quantities, it was changed to the "Canadian Military Pattern" (C.M.P.) and under this name was distributed



throughout the world. This line of trucks represented the highest degree of inter-company parts interchangeability ever achieved in any vehicle except the Jeep, and the Jeep was not produced until the war had been in progress for a long time.

It has been mentioned that interchangeability in the C.M.P. line of trucks decreased during the war. This was because as volume increased, one company would find that it could not continue to supply both itself and the other company with certain components for which it had until then been the sole source. The other company would then have to tool up but often would find that its machine facilities demanded slight modifications which affected interchangeability. Had design been available from the beginning, longer range planning would have prevented a great deal of this. The C.M.P. vehicles had a basically common cab. It varied only insofar as changes had to be made to fit the Chevrolet or the Ford chassis.

First vehicles were 4 x 2 but later 4x4, 6x4 and 6x6 vehicles were developed. The history of development of design of these and other chassis is given in greater detail in Volume IV.

The C.M.P. vehicles were definitely of military design. They were rugged, had short wheel base and large tires. As all-wheel-drive was developed for each size, orders were restricted to that classification as far as production capacity would permit. For less exacting service, and because of the limits of capacity for producting the C.M.P. type, a large number of "Modified Conventional" 4x2 trucks

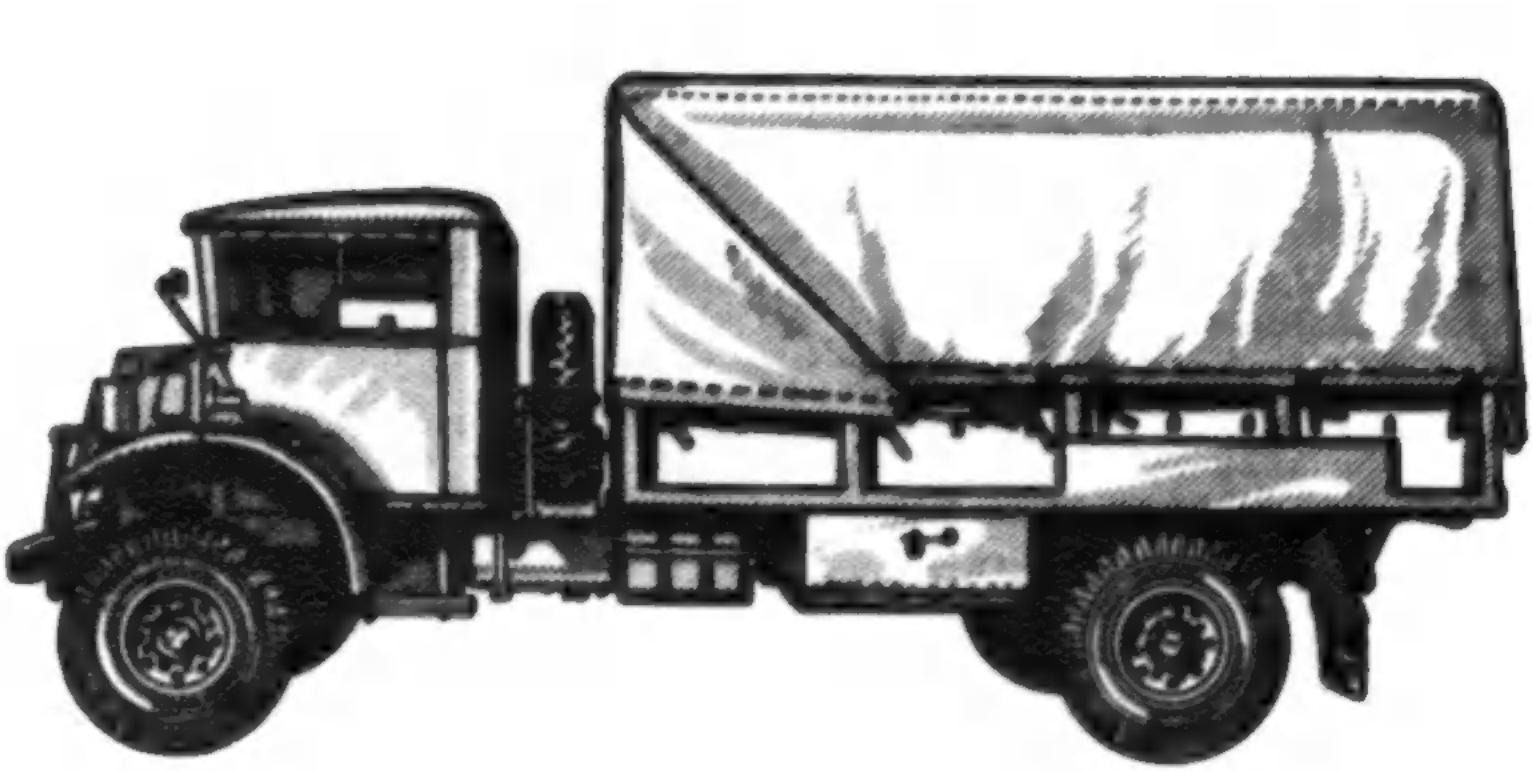
were produced. These vehicles were developed from commercial designs, but certain components were changed to those from a vehicle of a higher rating class, where military usage indicated such a necessity.

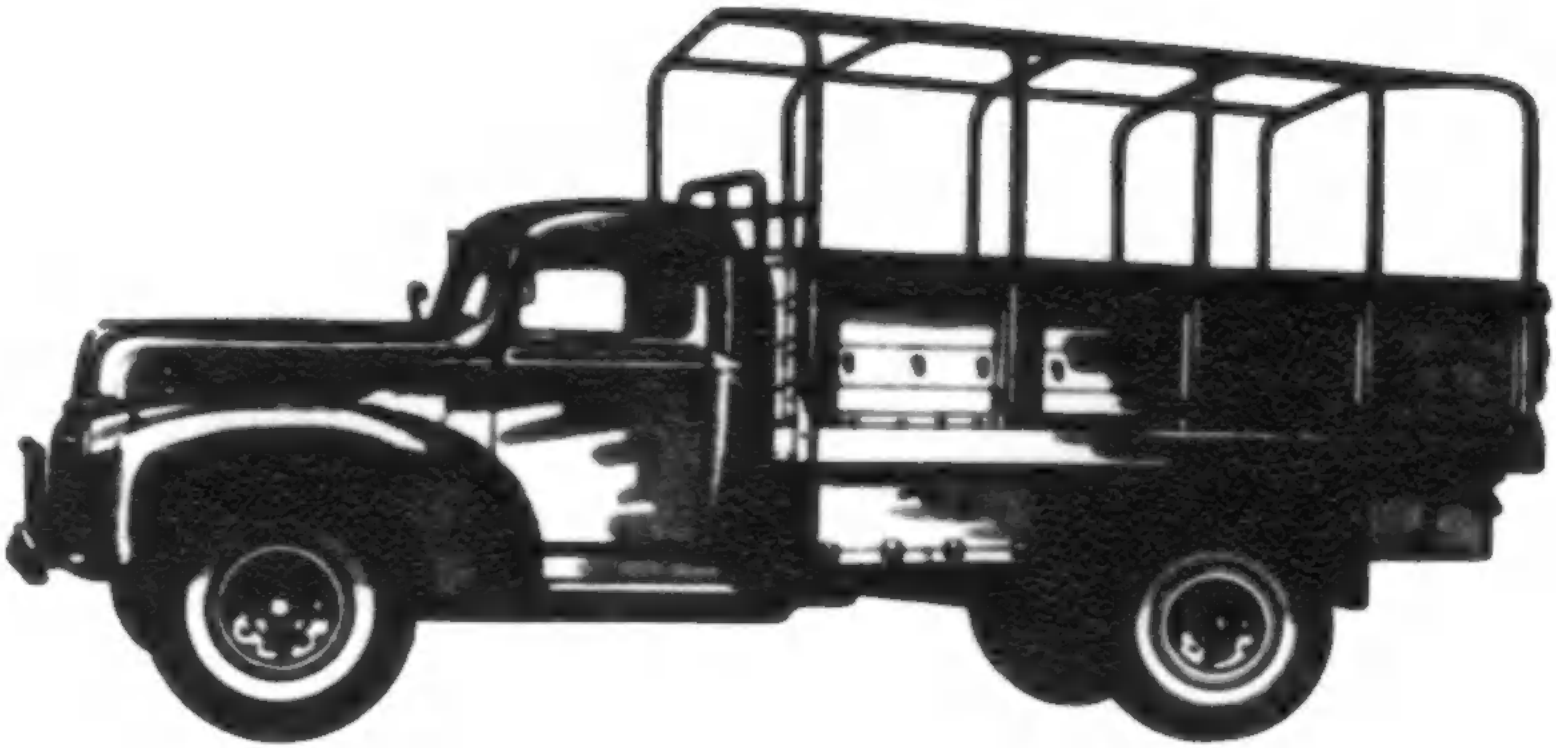
The following data indicates the time it took for certain vehicles to reach a production stage.

Approximate Dates of First Production.

D.N.D. 15 Cwt. 4x2	April, 1940
D.N.D. 8 Cwt. 4x2	May, 1940
D.N.D. 30 Cwt. 4x4	May, 1940
D.N.D. 3 Ton 4x4	May, 1940
D.N.D. F.A. Tractor 4x4	June, 1940
D.N.D. 15 Cwt. 4x4	Sept., 1940

The following approximate production figures are instructive.



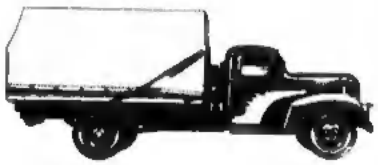


Deliveries During Fiscal Year April 1st, 1940 - March 31st, 1941.

D.N.D. ½ Cwt. 4x2	1825
D.N.D.30 Cwt. 4x4	3306
D.N.D. 3 Ton 4x4 134" W.B.	2473
D.N.D. 3 Ton 4x4 158" W.B.	360
D.N.D. 3 Ton 6x4	343
D.N.D. F.A. Tractor 4x4	829
R.H. Drive Sedans and Station Wagons	1343
Total Commercial Pattern vehicles delivered by Contractors	1458
Total D.N.D. Pattern Vehicles delivered by Contractors	14390
Total R.H. Drive Commercial Pattern vehicles delivered by Contractors	1343

First production was for the Canadian Armed Services. At the beginning, there appeared to be no need to consider supplying Britain; but in 1940, the U.K. commenced placing orders for Canadian vehicles. Initial orders were for commercial trucks or Modified Conventional trucks but soon orders came through for the Canadian Military Pattern type.

These British orders were augmented by orders from the Dominions and India, and later by orders from Russia, China and other Allies.



Chrysler was added as a source of Modified Conventional ½ & 2½'s.

These large additional orders had their effect on design. In some ways, they helped because they justified tooling up for certain designs peculiar to military requirements; in some cases, they hindered because of lack of remaining facilities to put improved design into effect.

In the initial stage of C.M.P. development, the British design was followed as closely as Canadian components and manufacturing facilities would permit. In this manner, both the good and the bad points were copied, and further, it is highly questionable whether the particular British make, which Canada was given as a model, was representative of the best U.K. design. Soon after delivery of C.M.P. vehicles to the troops commenced, complaints were received regarding the cabs. They provided insufficient room for the driver's feet; they were hot; and were generally unpopular. Certain changes were made to alleviate these conditions but it was obvious that a satisfactory cab could not be provided without radical change. Furthermore, such change would have to violate some military stipulations. In this particular case, overall height was the point in question. Canada developed a design in 1940 which, at a slight expense in silhouette height, provided a cab which was received enthusiastically by the troops and which was used for the remainder of the war. It had to be developed with speed as a prime requisite. It is, therefore, natural that it should not be perfect. One complaint, inaccessibility of engine, was largely overcome by subsequent modifications, but the cab was definitely too heavy and this point never was remedied as production facilities were too fully absorbed to permit a change.

The above story of the cab is given as an example of how design features of Canadian origin began to be used. This should not be interpreted as meaning that Canada started to break away from the policy of standardizing her basic vehicle design with that of the United Kingdom. Rather, it indicates that a stage in design was reached where it was found that wider adaptation to Canadian limitations produced a better all-round design than slavish adherence to British design detail.

In the opinion of the writer of this text, this is an extremely important point for consideration on the part of the future designers. We must standardize, as far as possible, with the U.S. or the U.K., or better still with both. Our manufacturing set-up may not allow us to do this 100% and still make most efficient use of production facilities. Where then is the correct breaking point between slavish adherence and originality? It is not the purpose of this report to discuss controversial problems. Its purpose is to record experience. Thus, we state, below examples of experience related to this question, which the future designer may find of value:

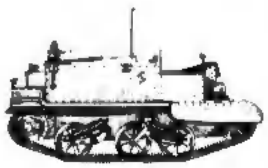
(1) The Director of Mechanization for 'B' vehicles of Ministry of Supply (T.T.2.) visited Canada in 1942. It was pointed out to him that Canada's forte in the automotive field was mass production of a limited number of types. He visited the various plants and learned the manufacturing possibilities. As a result, it was arranged that Britain's orders on Canada would be very largely restricted to vehicles of capacity of 3-tons and less, but that they would call for large quantities. It was further decided that the U.K., thereafter, would lay down certain dimensional and performance specifications and that, within broad limits, Canadian engineers would design to make the most out of available components and production potential; the U.K. not attempting to pass on every detail of design.

(2) Orders were received in such volume that production increased to the point where the C.M.P. vehicles were the largest of any design group within the Commonwealth. Thus they, themselves, became the most standard of Empire vehicles.

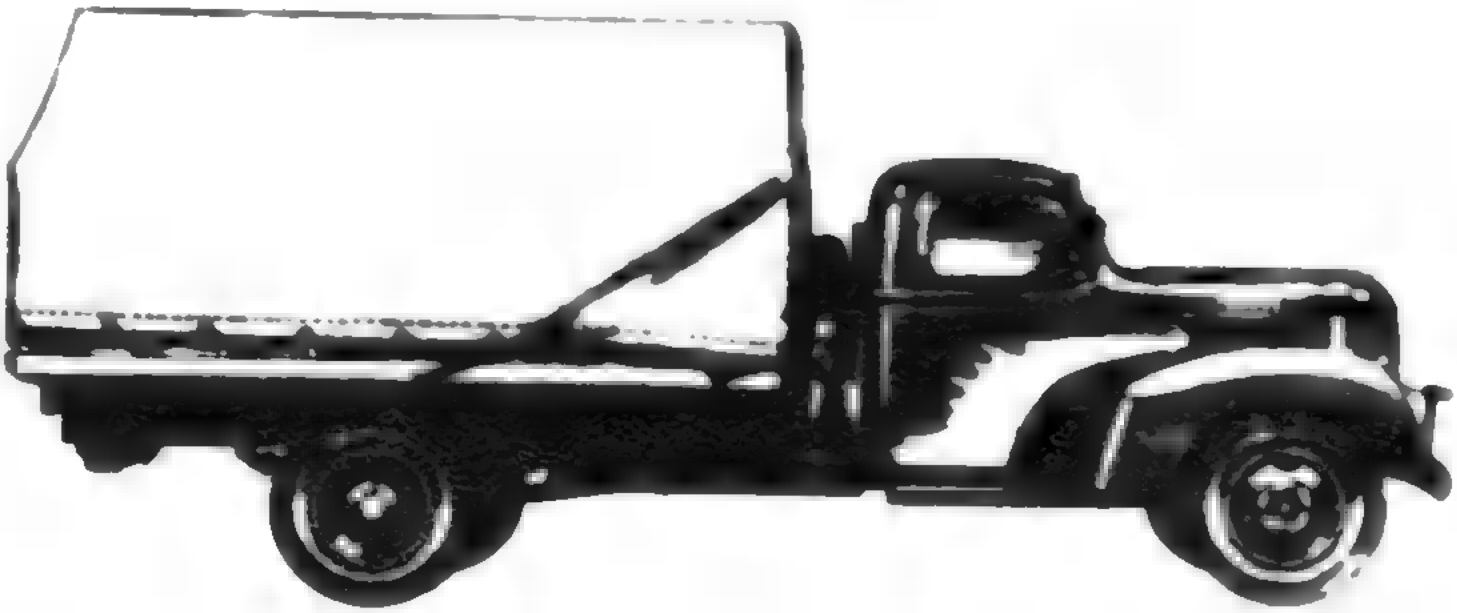
(3) At one time, the U.K. requested the development of a special vehicle and specified the use of a certain existing Canadian chassis to be used with a hull for which they gave dimensions. Canada found, on investigation, that the chassis would be grossly overloaded and as a result politely but firmly declined to develop and release such a design. After considerable discussion, Ministry of Supply requested instead that Canada develop a vehicle which would meet certain basic requirements as closely as possible, the result to be left to Canadian engineers. This was done and the resultant vehicle brought forth very complimentary comment from users in various parts of the world.

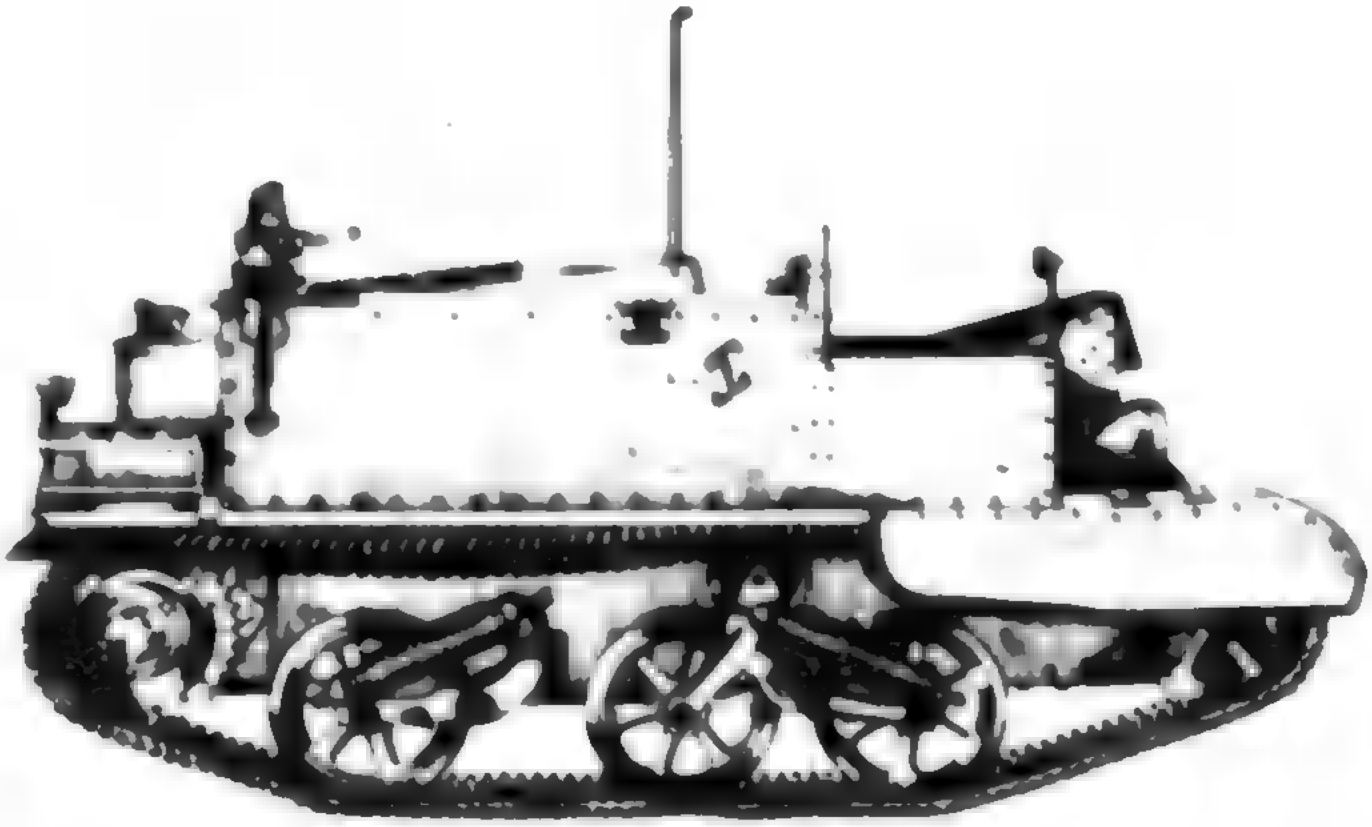
Carriers.

The vehicles already mentioned were all of the load-carrying types, or 'B' vehicles. Demands were shortly received for vehicles of more special design. Arrangements were made for Ford of Canada to produce the Universal Carrier and production commenced early in March

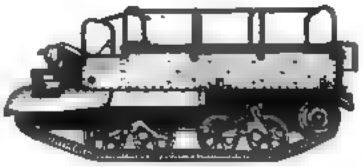


of 1941. This design followed that of the U.K. very closely. A large volume was produced.



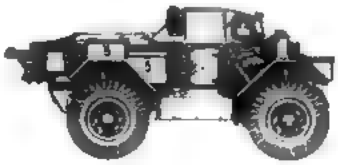


In the latter days of the war, the Universal was succeeded in Canadian production by the Windsor. Carriers [illegible] described in [illegible] detail in Volume II.



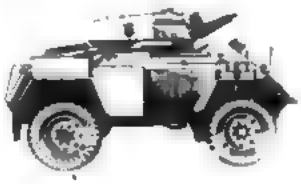
Armoured Wheeled Vehicles.

Later, the Ford Scout Car (Lynx) was



developed and General Motors produced the Reconnaissance Car (Otter),

and the Armoured Car (Fox).



Two experimental armoured trucks, the Universal Scout Car and the Caplad, [illegible] developed to a point nearing completion, but they were [illegible] put into production. [illegible] 15 Cwt. Armoured Truck was developed toward the end of the war and proved most useful.

All these armoured wheeled vehicles took many man hours of the [illegible] of designers and production [illegible] The Scout [illegible] and [illegible] 15 Cwt. Armoured Truck were the only ones produced in appreciable quantity.

Further description of the vehicles mentioned [illegible] the above two paragraphs may [illegible] found in Volume II.

[illegible]

Whereas [illegible] automotive industry exis- [illegible] in Canada before the [illegible], and wheeled vehicles of [illegible] types had [illegible]en built [illegible] assembled, Canada had to start from scratchontanks. It [illegible] not only necessary to obtainor develop design; it [illegible] actually necessary to adapt industry to [illegible] entirely new type of product.

The development work of tanks [illegible] allied vehicles caused many problems in both engineering and organization. Tank work [illegible] fairly sharply separated [illegible] automotive, being performed chiefly in locomotive shops.

[illegible] plate development for both tanks and [illegible] vehicles and carriers required new work [illegible] [illegible] part of Canadian metallurgists, engineers [illegible] industry.

As [illegible] [illegible] possible to combine all [illegible] tank [illegible] into one volume of this vehicle record, [illegible] history of tank development is given in fairly full detail in that volume (Volume III). Therefore, for purposes of these general comments, [illegible] following list of tank-type vehicles is probably sufficient:

Tank, Valentine,

Tank, Cruiser, Ram,

Tank, Cruiser, Grizzly,

Tank, Command, O.P.,

25 Pdr. S.P. Tracked Sexton,

Tank, A.A. 20 M.M. Quad., Skink.

Design for Abnormal Conditions.

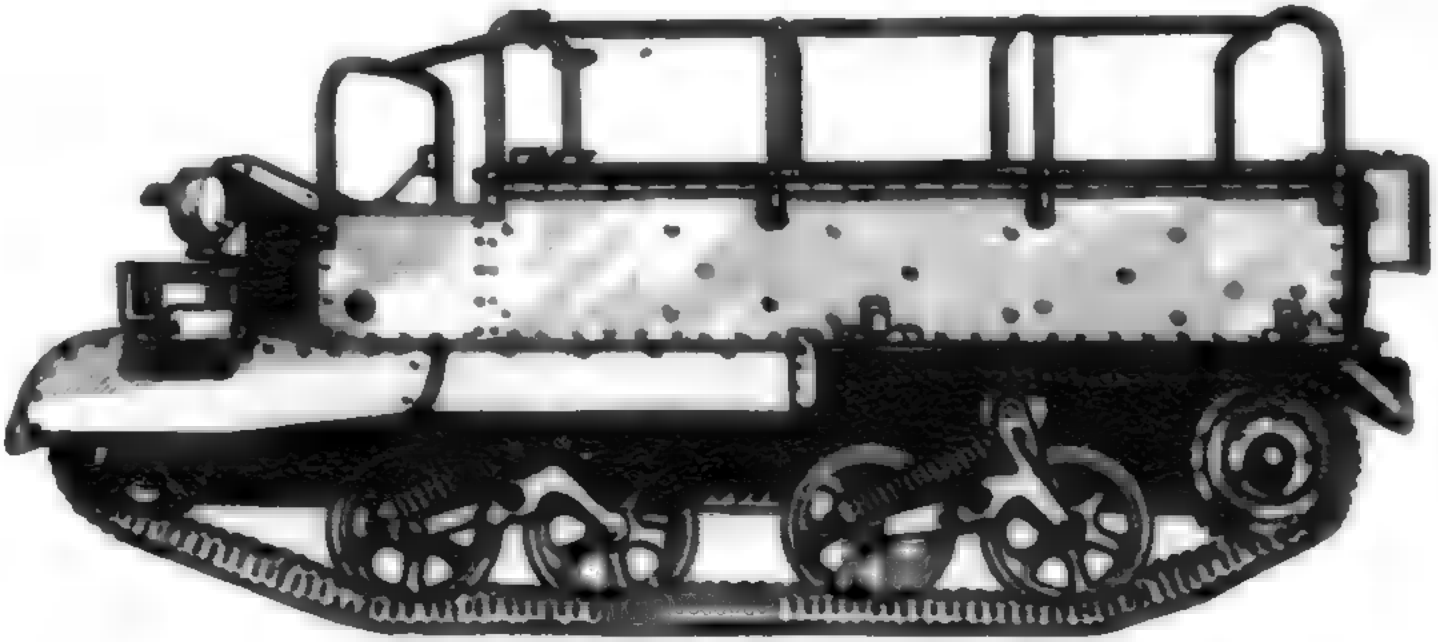
Considerable work [illegible] [illegible] in developing design which would permit vehicles to operate under abnormal conditions.

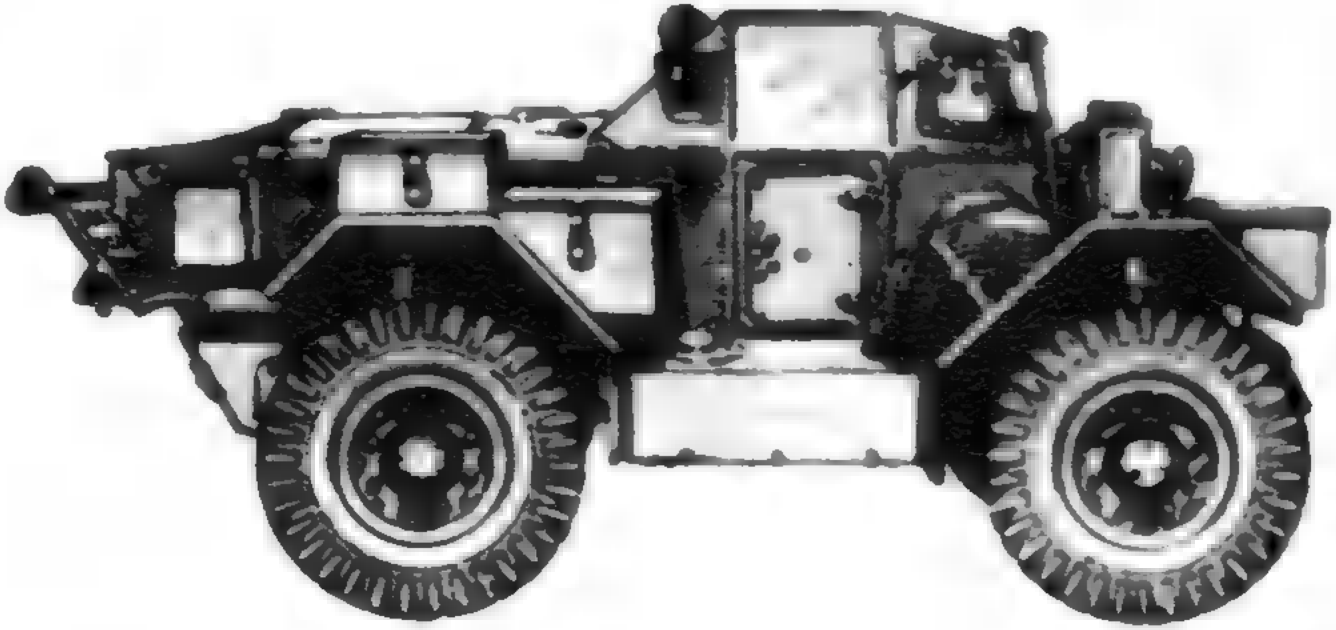
The operations in North Africa resultedin [illegible]s for a high degree of dust-proofing; also for radiator overflow tanks to prevent the loss of water. A hurried request [illegible] received from U.K. to develop equipment which would permit vehicles to operate satisfactorily at -40°F; consequently, an arctic-proofing development programme of appreciable magnitude was carried on for two years.

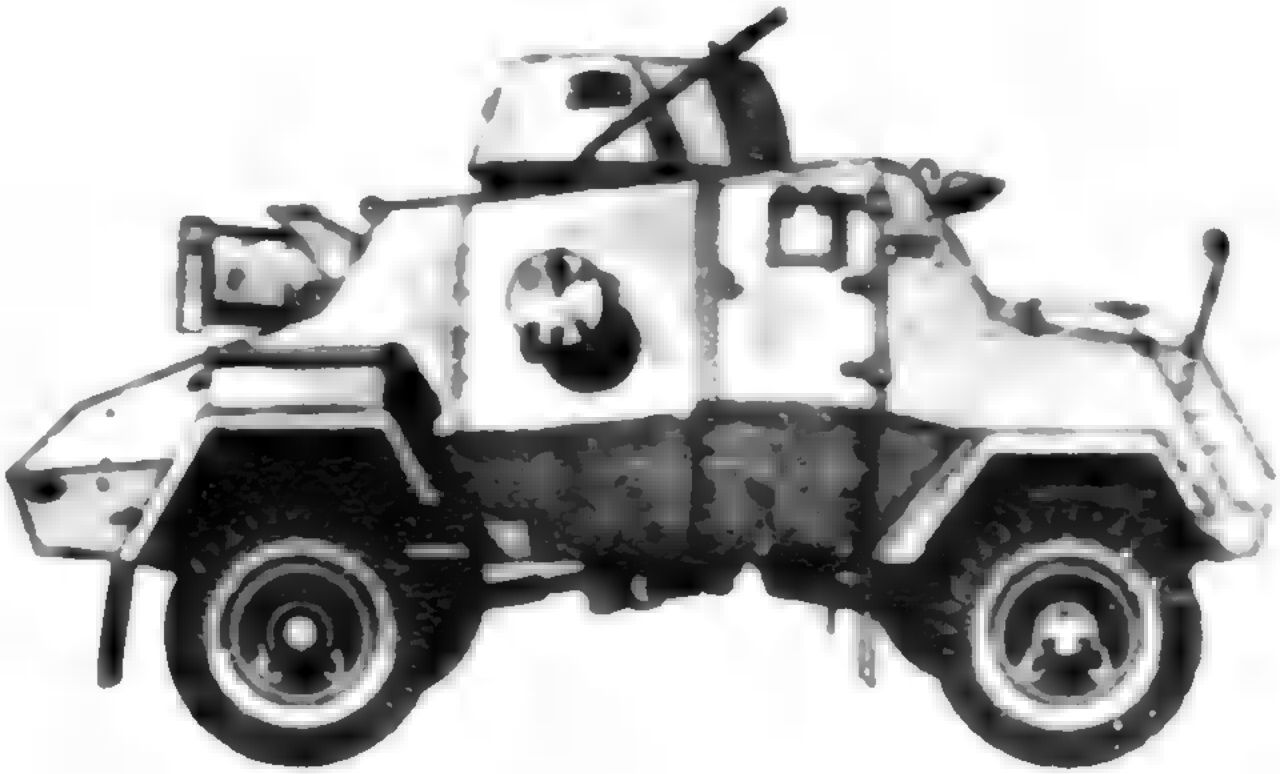
The developing of wadeproofing commenced with studies on how to make existing vehicles wade, but eventually wadeproofed wheeled vehicles were turned out by the factories. Development of tropic or climate-proofing had progressed far by the [illegible] of hostilities.

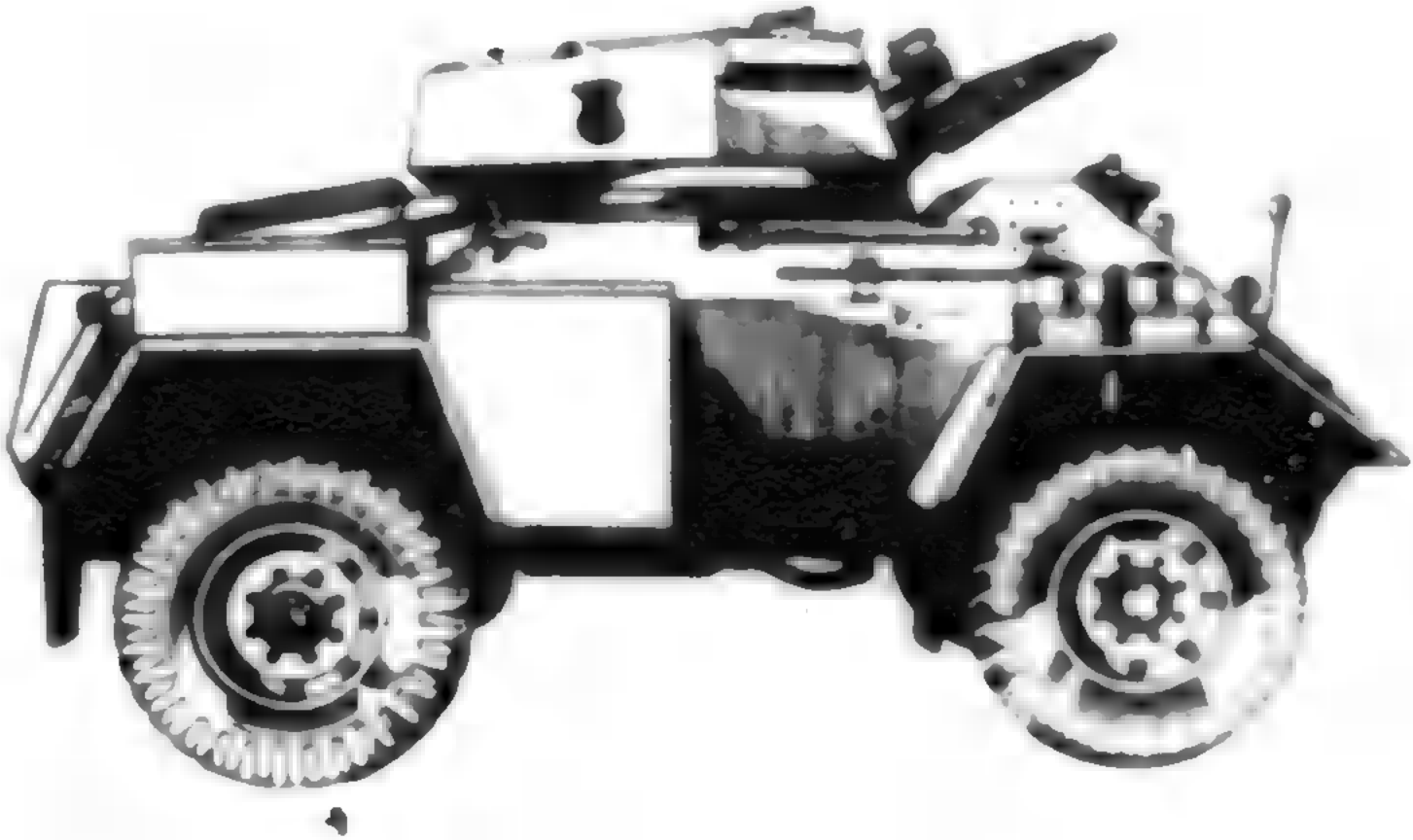
Airportability became a requirement and volume Canadian 4 x 4's were being produced to A.A.T.D.C. requirements by the [illegible] of the war.

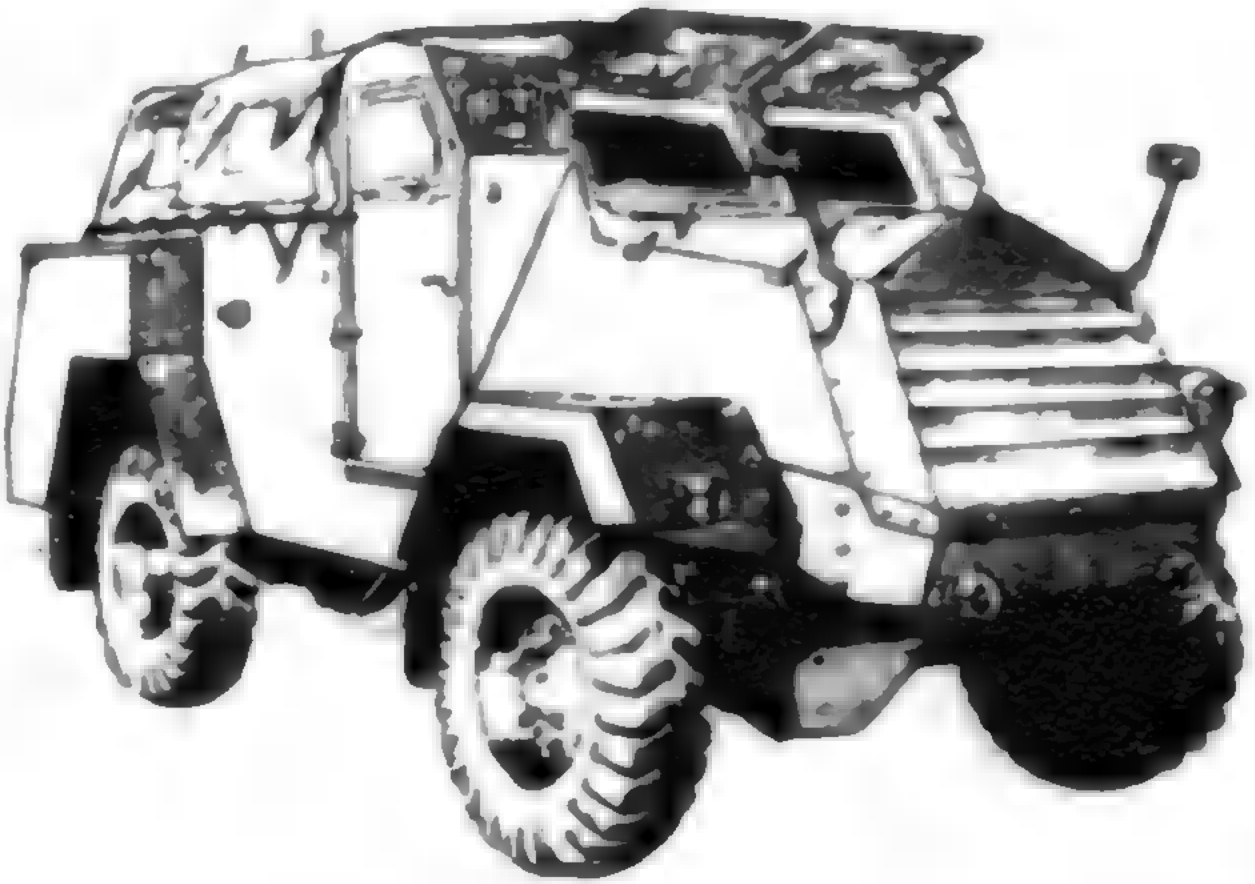
For furtherdetails onthese subjects,

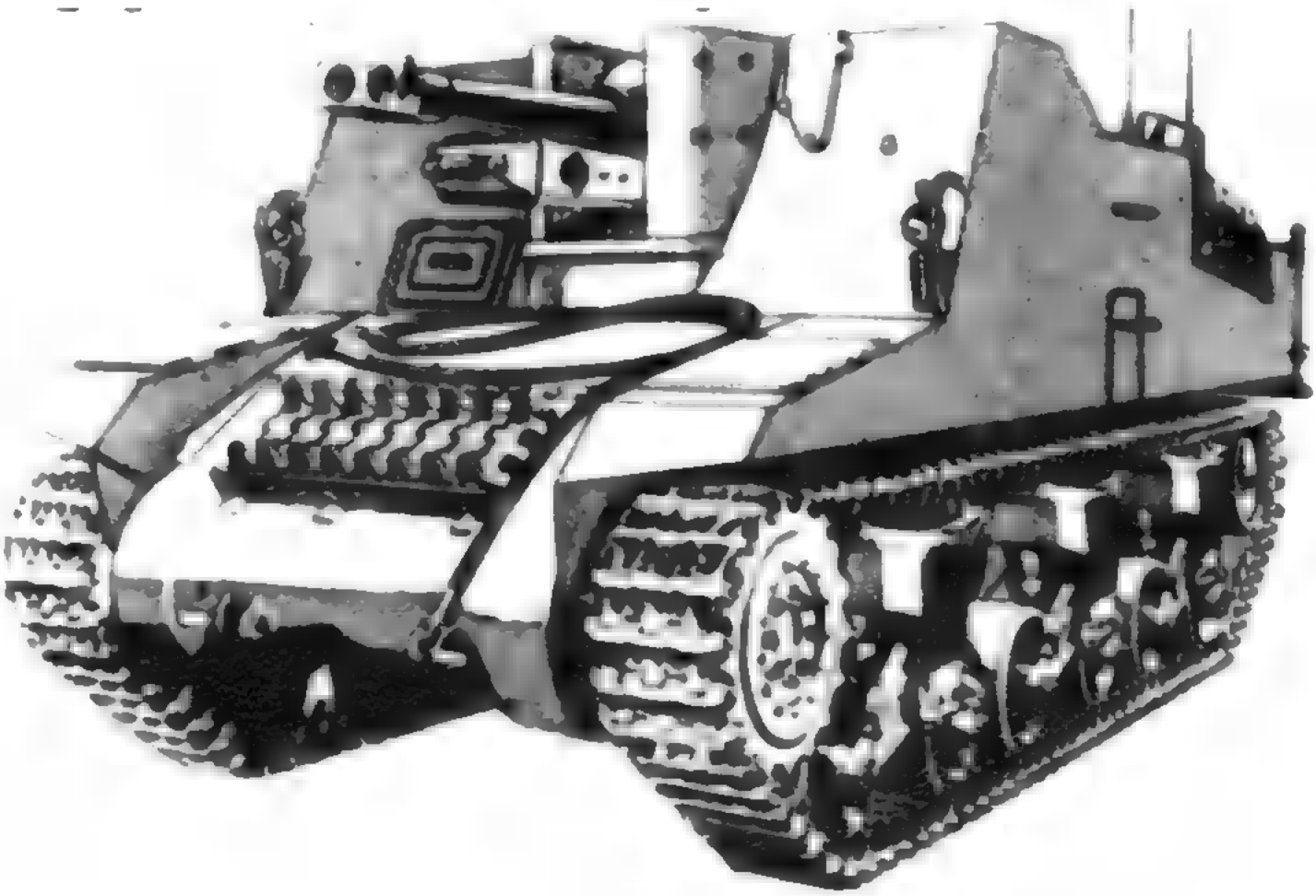


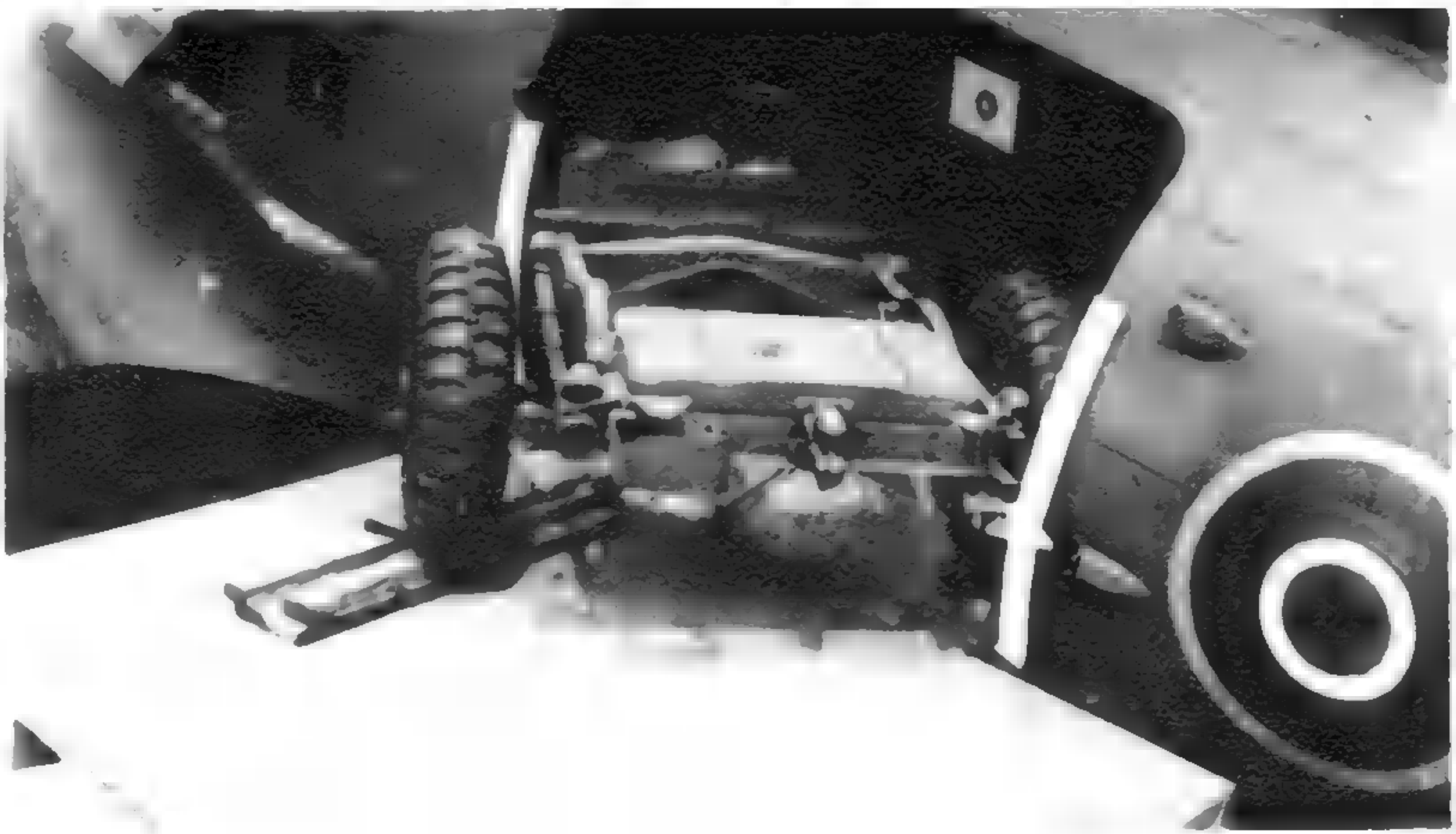












Volume IV.

Bodies.

Body development is described in detail in Volumes V and VI. A few points are particularly worthy of note.

(1) The truck body industry in Canada is very much the opposite of thechassis industry. In the case of the latter, three large plants hold a dominating position and are equipped with good engineering facilities and huge production potential. On the other hand, there are no truck body companies which can compare in size with any one of the automotive companies. In peacetime, the truck body industry builds bodies for only a minor percentage of chassis produced. During the war, they had to build bodies for almost all chassis. Thus there were a great many small companies producing beyond any previous volume. These companies were not equipped to do all necessary design work; consequently Army Engineering Design Branch had, of necessity, to go much further in providing complete detail design to the Body companies thanit did to the chassis manufacturers.

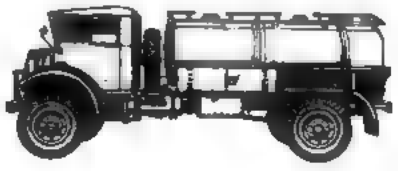
(2) Bodies were built overly heavy as a result of playing safe where necessity for speed did not permit detail studies and refinements. Later, progress was made in lightening bodies on a design development basis and experimental samples were built in which dead weight was reduced by 40%, and which have shown up well in tests. Every pound saved in body weight adds to vehicle performance, to chassis life and to tire life. It is suggested for future design that serious consideration be given to -

(a) arriving at the right compromise of body-weight vs. chassis performance and durability;
(b) use of special material and an increase in metal-forming in order to provide maximum strength at minimum weight.

(3) The body industry was grouped together into an organization known as the Steel Body Manufacturers' Association. This made it possible to deal more efficiently with the large number of small contractors. It also made it possible, from a design point of view, to maintain a degree of standardization which would not otherwise have been possible.

Technical Vehicles.

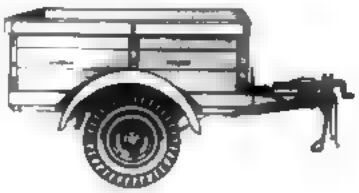
This subject is covered in detail in Volume VI. These vehicles called for a tremendous amount of detail development. Each type is a different type of workshop, stores lorry, breakdown vehicle, tanker, bridging lorry, etc., and the number of types was very high as may be noted by glancing through Volume VI.



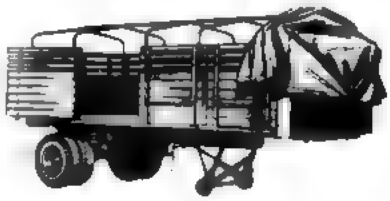
Arrangements were made that the Chrysler Corporation of Canada should handle machinery lorries, doing the detail design; also doing the installation, in the vehicle, of the special technical equipment. The tremendous amount of detail required resulted in an appreciable number of technical staff being loaned to A.E.D.B. for this purpose.

Trailers.

These are described in Volume VII, in detail. It is probably sufficient to say here, that at the beginning of the war trailers, especially semi-trailers, were not favoured by all military users. However, by the end of hostilities, trailers were being produced in large numbers. The majority of trailer contacts with contractors were handled through the Steel Body Manufacturers' Association.



A determined effort was made to standardize between one trailer and another, and between trailers and prime movers as far as applicable components were concerned. This was a very difficult target to hit, however, because requirements for different types of trailers arrived suddenly without any warning and it was very difficult to fit theminto the general scheme of things sufficiently to produce the greatest degree of standardization.

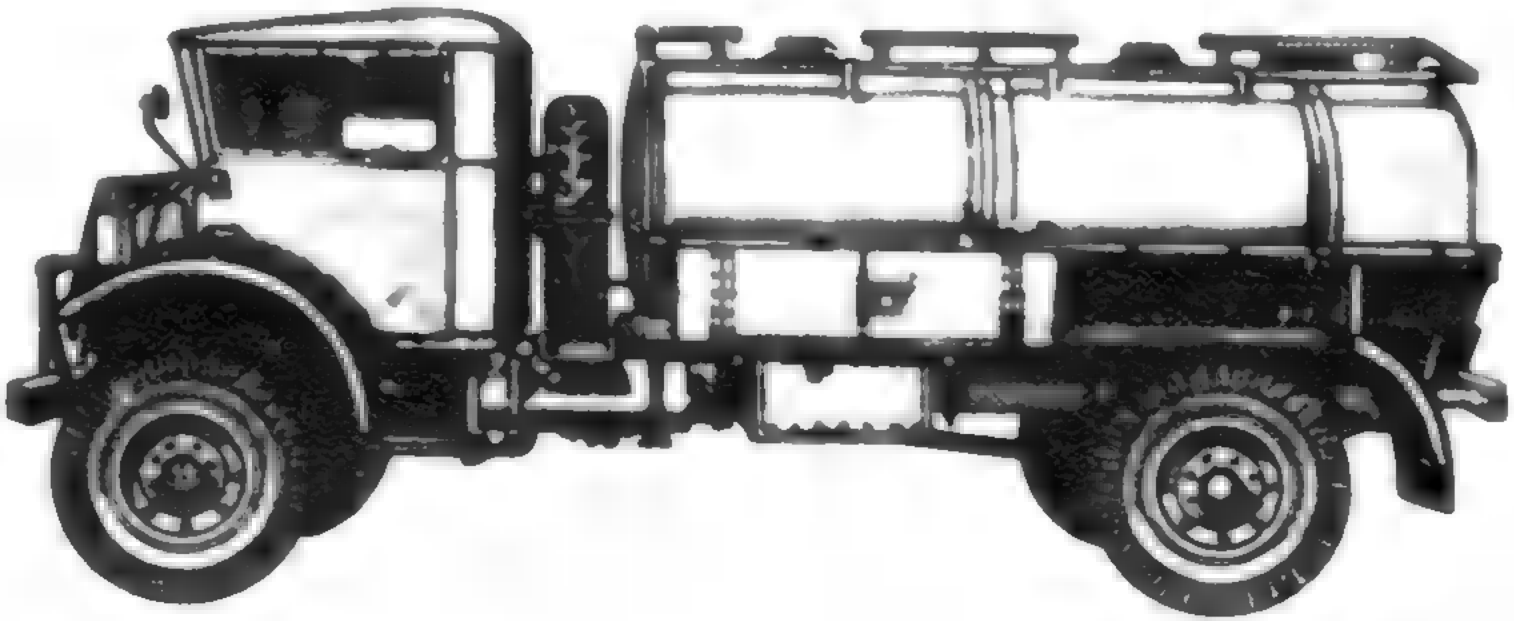


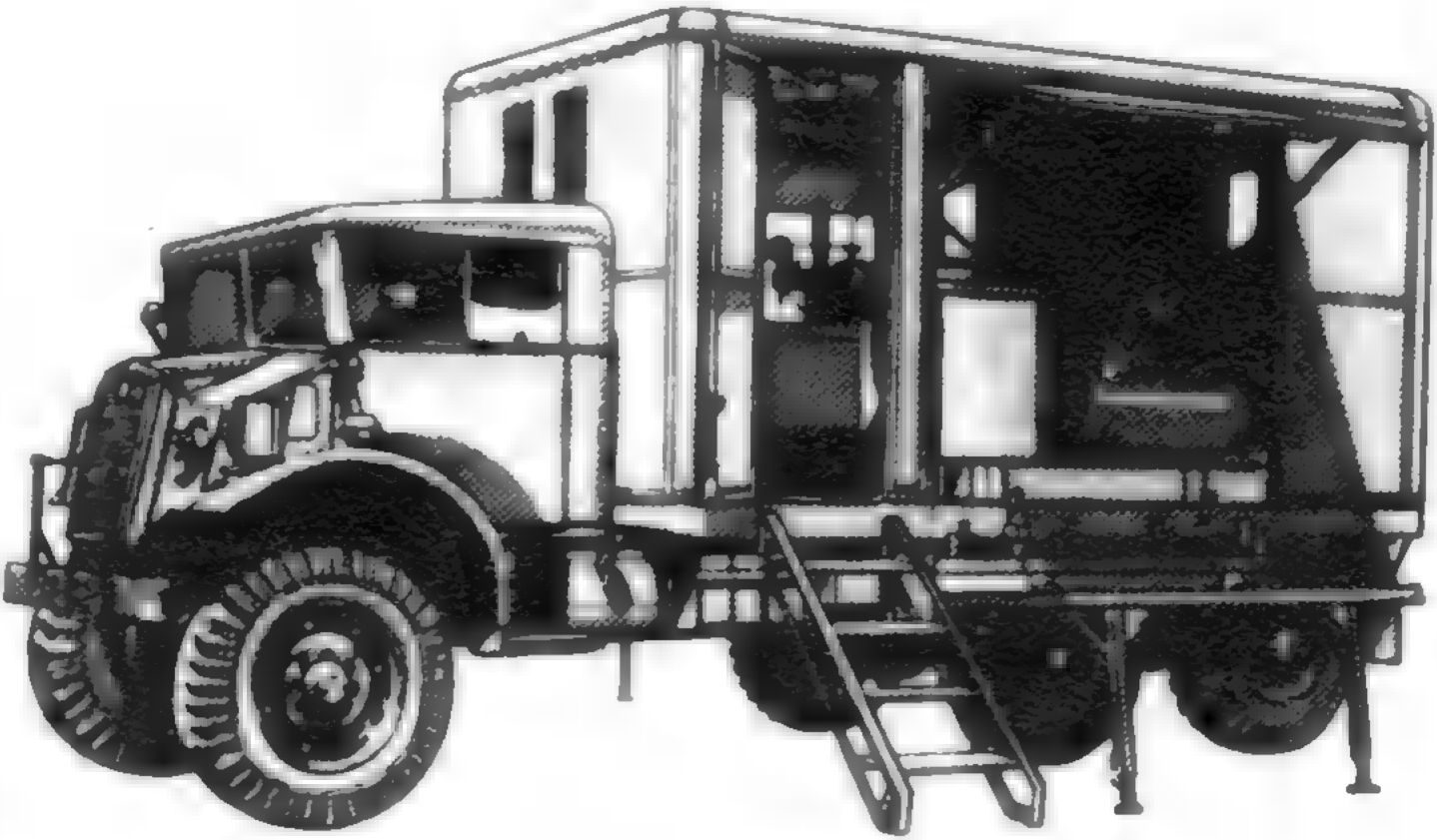
It is suggested for future design consideration that an endeavour be made to establish basic trailers of different types, following which relationship of components to other trailers and to prime movers should be carefully studied.

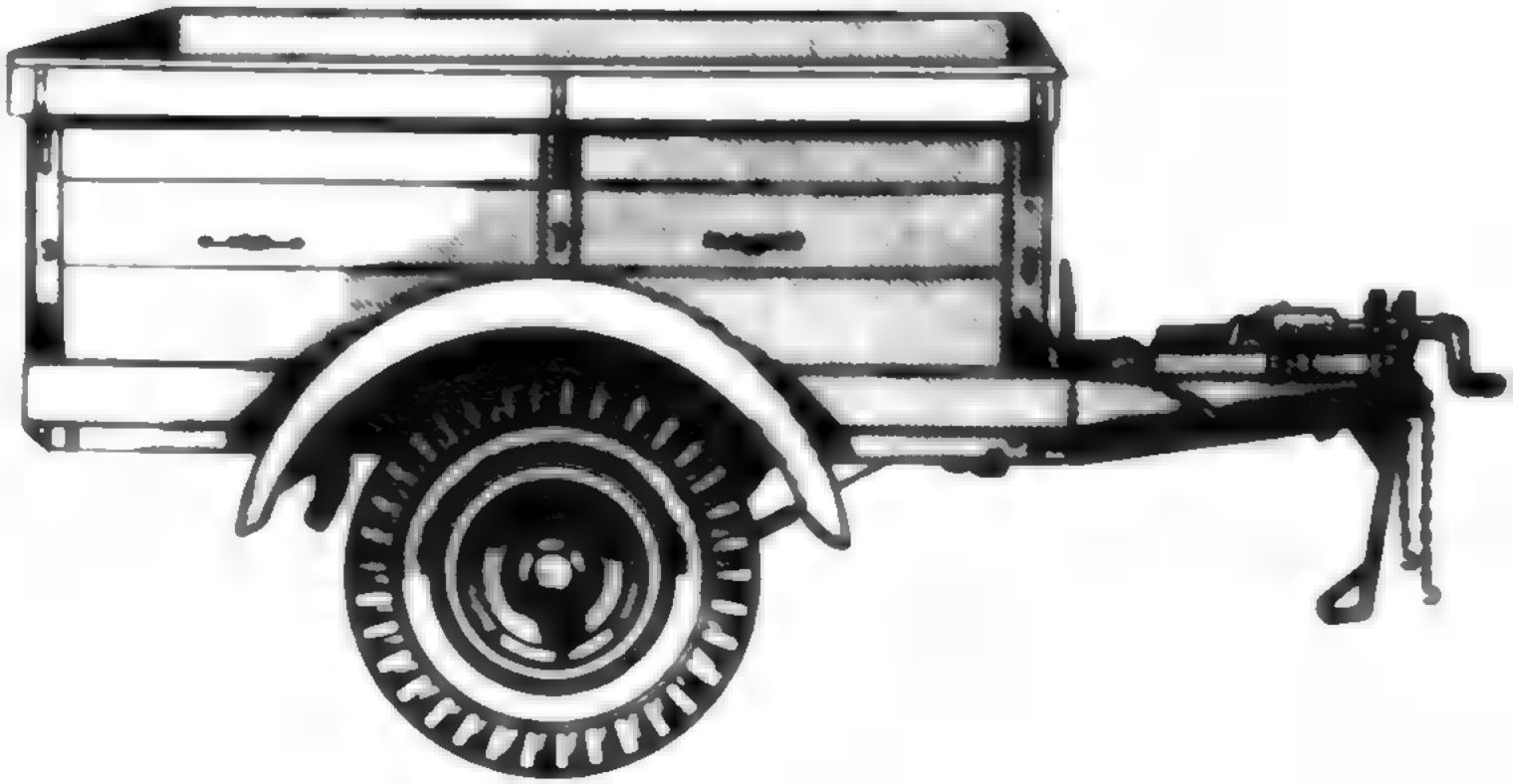
Mud and Snow Traversing Vehicles.

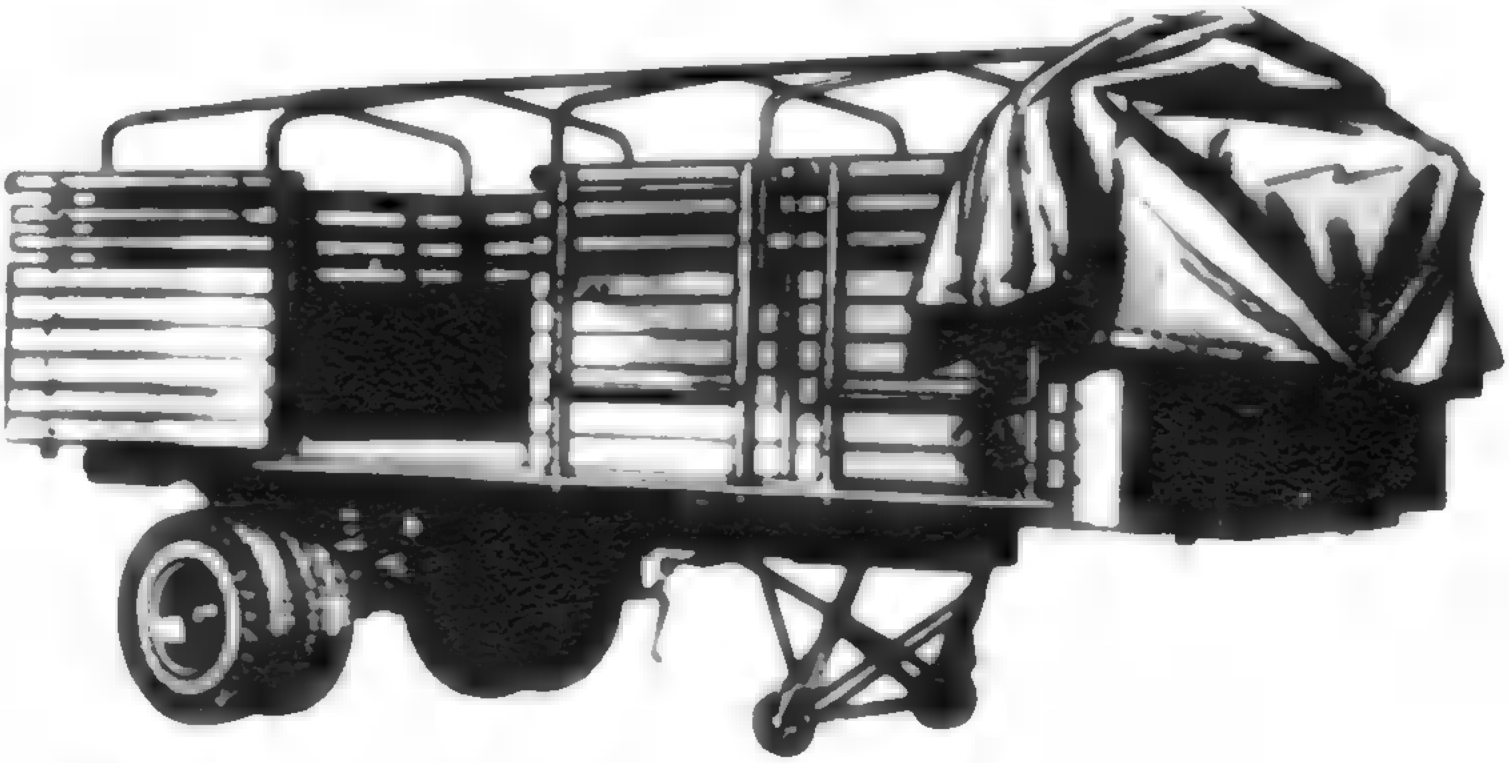
This is a subject unto itself and as such is described quite fully in Volume VIII. For this reason, there is no justification in taking further space here, except to say that judging by the exercises which have taken place to date, the Canadian developments for snow traversing have resulted in the most reliable equipment and equipment best suited to the requirements demanded by the three exercises, Polar Bear, Eskimo and Lemming.

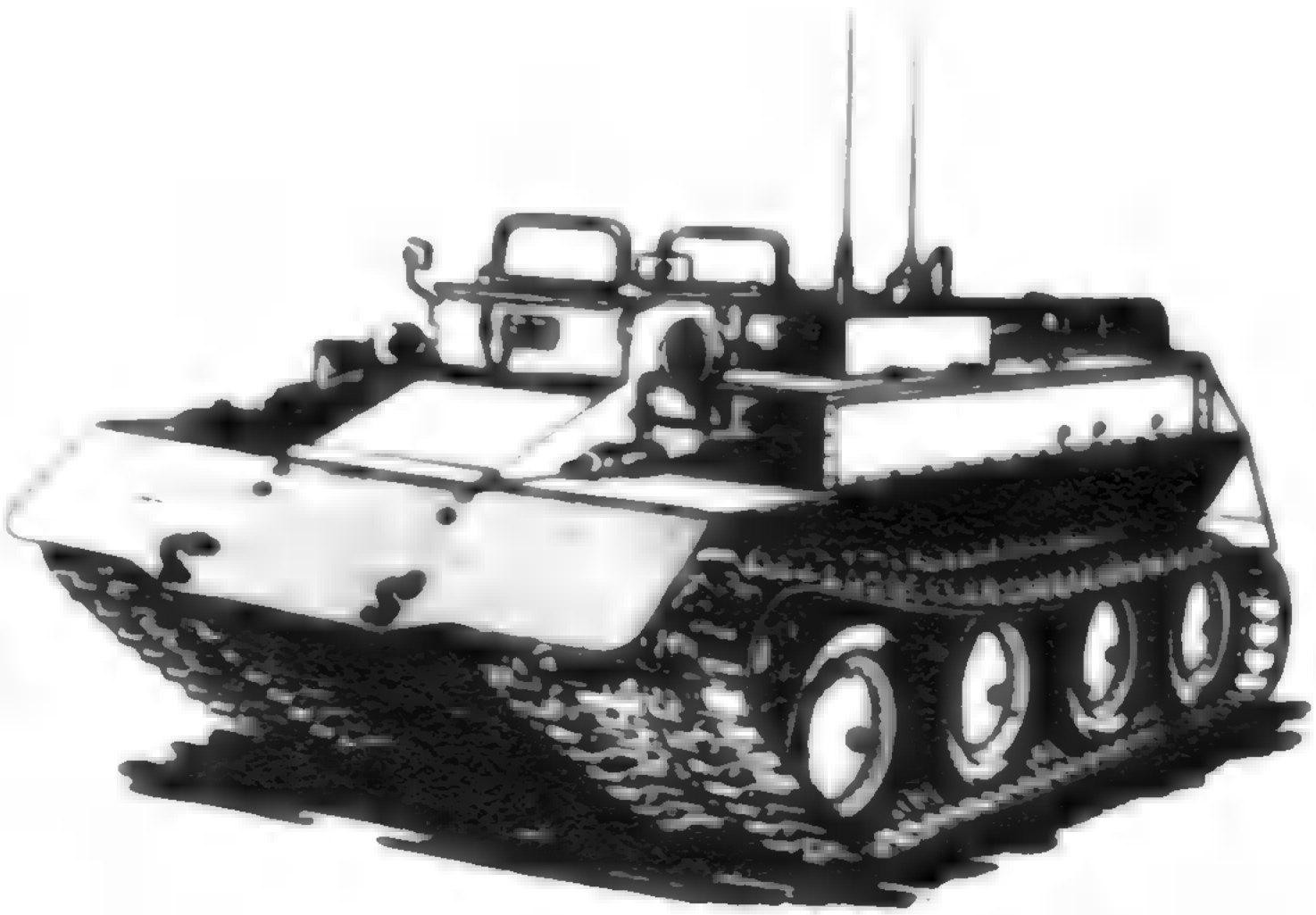
There is a long way to go before snow-traversing vehicles can be calledentirely satisfactory, but a good foundation has been laid.











As a summary of the result of the vehicle design, [redacted] history of which has just been sketchily given, there is probably no better comment than a list of [redacted] was actually produced during the war. This list follows:

CANADIAN VEHICLE PRODUCTION.

WORLD WAR II (UP TO SEPT. 1, 1945)

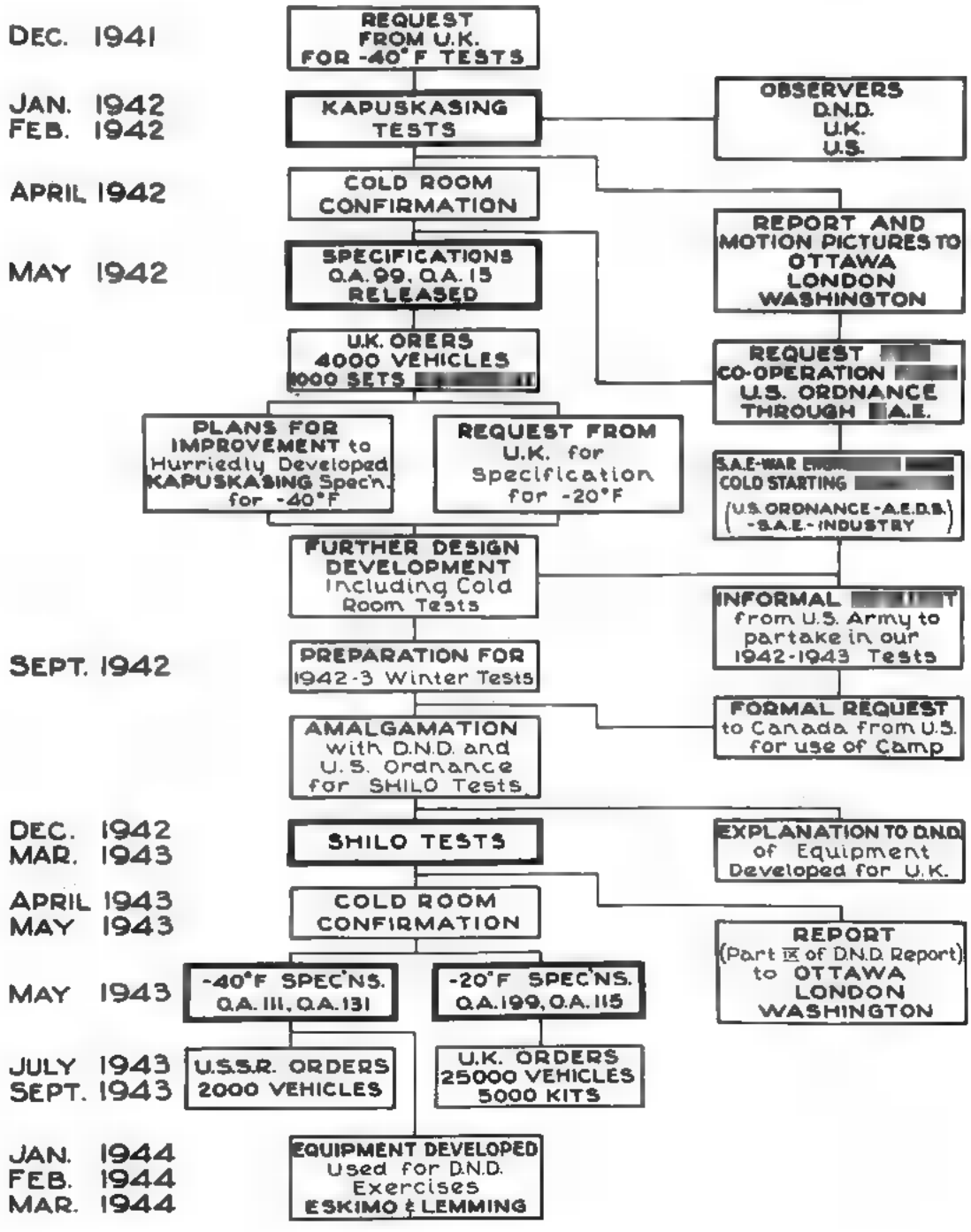
List of vehicles produced during the [redacted] for the Canadian [redacted] Services [redacted] Allies:

Vehicle Model		Type and Quantity	[redacted]	Percentage of Total
		[redacted] Military Pattern		
[redacted] Cwt. 4 [redacted] 2		9,837		1.14
Heavy Utility 4 [redacted] [redacted]		12,967		1.51
15 Cwt. [redacted] [redacted] [redacted]		34,195		3.98
15 Cwt. [redacted] [redacted] [redacted]		69,227		8.08
30 Cwt. 4 x 4		19,319		2.24
3 Ton 4 [redacted] 2		6,000		.70
3 Ton 4 x 4		209,004		24.40
F.A.T. 4 x [redacted]		22,991		2.62
3 Ton 6 x 4		4,123		.48
3 Ton 6 x 6		2,710		.31
Trailers		19,663		2.29
	Total	409,936	409,936	47.75
		Modified Conventional		
15 Cwt. 4 x 2		88,096		10.28
30 Cwt. 4 x 2		21,188		2.47
3 Ton 4 x 2		197,073		23.00
	Total	306,357	306,357	35.75
		Armoured		
Universal Carriers		28,992		3.37
Windsor Carriers		5,000		.58
Cars, Armoured		1,506		.17
Cars, Light Recce.		1,761		.20
Scout Cars		3,255		.38
Truck Armoured		3,961		.46
Tank Valentine		1,420		.16
[redacted] Cruiser Ram		1,948		.23
S.P. 25 Pdr. Sexton		2,122		.25
Tank Cruiser Grizzly		189		.02
Tank Command O.P.		84		.01
Tank AA 20 MM Quad Skink		1		
	Total	50,241	50,241	5.85
		Miscellaneous		
Station Wagons, Staff Cars and Miscellaneous 4x2's		81,942		9.55
Rear Engine 4x4 (India Only)		9,494		1.10
	Total	91,436	91,436	10.65
		Grand Total	857,970	100

Projects varied from those which were quickly handled to those which were complex and which, consequently, [redacted] considerable time.

In order to illustrate the progress of an assignment; how it went through various stages; how it was affected by outside influences and how its effect spread beyond original planning, there is shown below a graphic history of the development of the Arctic-proofing Specifications:

DEVELOPMENT OF ARCTIC-PROOFING



STANDARDIZATION

In the light of the experience gained in World War II the importance of standardization cannot be over-emphasized.

Standardization affect:-

Manufacturing,
Shipping and Distribution,
Quantity of Vehicles Required,
Flexibility of Military Operations,
Maintenance.

"Standardization" is a very broad term. In this chapter, it is intended to apply to (1) Types of Vehicles and (2) Vehicle components.

The ideal in vehicle standardization would be to have the same vehicle used in any given capacity-class by the United Kingdom, the United States and Canada. A very close approach to this was reached in the case of the 3/4 Ton Dodge. However, manufacturing complications prevented complete standardization between this vehicle as produced in the U.S. and as produced in Canada. The chief point of difference was the engine. As the U.S.engine was not produced in Canada, a Canadian-made Dodge engine was substituted in the Canadian-produced vehicle. As the engine is the heart of a truck, it might be considered that this substitution constituted a disastrous violation of standardization; and this would have been true had it not been the case that there were already in the field approximately 100,000 other Dodge vehicles equipped with this Canadian engine.

The Canadian Military Pattern group of vehicles represented a high degree of standardization in that there existed a large amount of component interchangeability between the vehicles built by Ford and those made by General Motors. There was also a large number of components which were used in more than one class of vehicle (e.g., 3 ton 4 x 4 truck, 3 ton 6 x 6 truck, and 15 cwt. truck).

The U.S. Jeep was probably the most highly standardized vehicle produced during the war. It was made by more than one manufacturer and yet nearly all components were interchangeable. Nevertheless, this vehicle had very few parts which were interchangeable with those of any other class. Similarly the U.S. G.M. 2½ ton 6 x 6 which was produced in huge quantities was not built on a broad basis of component interchangeability with other vehicles.

Thus, we may obtain standardization or interchangeability in two ways:-

(1) By building all vehicles of one class with completely interchangeable units; but treating as secondary any interchangeability with vehicles of other classes (e.g., Jeep).

(2) By using a limited number of kinds of different components in as wide a range of vehicle types as possible and at the same time making as many parts interchangeable as can be done (e.g., C.M.P. vehicles).

Alternative (2)above was the obvious method for Canada and would appear to remain so for the immediate future. By this means Canada was able to use, in both C.M.P. types and in Modified Conventional types, the full capacity of the Ford and General Motors Canadian engine plants. Had the policy been laid down that only one type of engine could be used, one plant would have been non-productive during the tooling up process. On the other hand, if one class of vehicle had been given to Ford to be equipped entirelywith Ford engines, while another class was given to G.M. and equipped entirely with Chevrolet engines, it is almost certain that one plant would have been overloaded while the other was working below capacity.

It must be realized that the Jeep was produced by one firm only in the early stages. Additional manufacturers had to tool up completely before their plants became productive.

Canadian and British R.C.E.M.E. and R.E.M.E. officers who served in Italy and N.W. Europe have been questioned regarding the disadvantages presented by the use of two engines, in the C.M.P. line of trucks. They stated that while one engine would have increased simplicity, nevertheless the Ford and Chevrolet truck and engines were distributed in such vast quantities that the maintenance problem was not acute on this account. They did object to lack of interchangeability on some of the more detail parts (e.g., transfer case).

Unfortunately, interchangeability decreased in many respects during the war, as already mentioned in a previous chapter, ("Design Development"). Apparently, the only way this might have been avoided would have been through longer term planning which in turn would have been dependent on design being available in advance.

-X- -X- -X- -X- -X- -X- -X- -X-

One of the most serious problems of the war was the distribution of spare parts. Interchangeability reduces the types to be carried and thus, in turn, the total quantity.

Standardization was aid to maintenance needs no discussion. It is universally admitted. It may not be fully realized, however, that the larger the degree of standardization the lesser the number of stand-by vehicles there are required. This is because spare parts are more likely to be available and because repairs can be made more quickly. Thus, establishments may be reduced by standardization.

Standardization of vehicles was established early in the war in order to permit vehicles to roll off the end of the assembly line and be placed in storage, pending shipping facilities. Without this, vehicles might have stood idle while shipping to one destination was available, simply because the vehicles had been built with some feature which was especially intended for a different destination. This was most important because it,

(1) permitted continuous production of vehicles on the most favourable production basis;

(2) permitted the building of a bank of vehicles thus making possible the taking advantage of all available shipping facilities;

(3) permitted re-routing.

DESIGN ORGANIZATION

When [redacted] began, both design and procurement were the responsibilities of a bare handful of D.N.D. officers. The pressure under which they were called upon to work [redacted] tremendous [redacted] how they stood up to it has been a wonder to other engineers who [redacted] subsequently called upon to reinforce them. It may not [redacted] fully realised [redacted] much the Canadian vehicle programme, which subsequently reached a state where it represented 25% of Canada's dollar output of munitions, was dependent upon two men at the initial stage. These two [redacted] initiated the programme which started industry developing vehicles composed of Canadian components. Reinforcements to this small Government group [redacted] obtained through industry. Slowly but [redacted]ly an effective organization began to materialise, until, at peak, a staff [redacted] 199 existed. This staff included engineers, test technicians, technical service men, draftsmen, commercial artists, blueprint, photostat and duplicating operators, photographers, stenographers, typists, clerks, etc. It [redacted] [redacted] up of both civilian and military personnel.

[redacted] chief function of this organization [redacted] to obtain or develop a specification which would [redacted] part of a contract for building a particular type of vehicle. To fulfil this requirement, the Government design group became a link between the user and industry. The large automotive companies possessed design staffs [redacted] [redacted] therefore able to proceed with the development of detailed design based upon the requirements provided by the Government design group. The latter had to maintain close contact in order to [redacted] or obtain decisions when necessary and in order to provide information as required by the contractor. Standardization or interchangeability of components necessitated careful watching by the Government group. In the [redacted] of smaller companies, such as body companies who did not possess adequate engineering staffs, it became [redacted]ecessary for the design group to do [redacted] original detail work.

[redacted] [redacted] previously, the initial orders for Canadian vehicles [redacted] for Canadian account only but, following Dunkirk and during the Battle of Britain, the U.K. commenced to purchase Canadian automotive products in [redacted] increasing numbers. It soon became apparent that it would be advantageous to have one group controlling the design of all Canadian vehicles, irrespective of the ultimate destination. This would permit controlled compromises of design between varying Government demands and [redacted]ble industry to build up vehicles which [redacted] standard in design to the greatest possible extent. [redacted] arrangement would also facilitate production and result in a more satisfactory supply situation. For these [redacted] the design group [redacted] [redacted] from the Department of National Defence [redacted] transferred to the Department of Munitions and Supply. There it [redacted] shortly made a major [redacted]rt of [redacted] Army Engineering Design Branch.

The work on vehicles was divided between two Directorates, the Directorate of Automotive Design and the Directorate of Tank Design. The division of responsibilities between these two Directorates was determined more [redacted] the basis of the way in which industry was organized than by [redacted] vehicle types which were to be produced. Everything which [redacted] produced by the automotive industry [redacted] considered to [redacted] responsibility of [redacted] Director of Automotive Design. All projects carried out by the Tank Arsenal [redacted] its associated heavy industry contractors [redacted] allotted to the Director of Tank Design. Within these Directorates, sub-divisions [redacted] made which again [redacted]re related to the industrial set-up. For [redacted]le, within the Directorate of Automotive Design, the normal contact with Ford, General Motors [redacted] Chrysler [redacted] through the Chassis Engineer; with the body manufacturers, through the Body Engineer; with the tire and rubber industry, through the Tire [redacted] Rubber Engineer.

The [redacted] for this type of breakdown or division of work was two-fold,

(1) to narrow the field of responsibility for which the Government engineer [redacted] responsible within such limits that he could act efficiently and

(2) so that industry would not [redacted] hampered by a large number of individual contacts by different people. This latter point [redacted] [redacted] important consideration very early in the work.

A third Directorate, that of Metallurgy, acted for both [redacted] vehicle Directorates. Its advice [redacted] invaluable in many respects, especially when the supply of certain materials became critical, [redacted] its chief work [redacted] [redacted] plate. A separate development record is being produced by [redacted] Director of Metallurgy.

Within its duty of acting as a link between the [redacted] [redacted] industry, the Army Engineering Design Branch [redacted] responsible for the following functions:

(a) Uniting the technical staffs of Industry,

(b) Supplementing industrial designing where necessary,

(c) Interpreting User requirements and transmitting to Industry,

(d) Providing official specifications to be used as parts of contracts; and making subsequent amendments and deviations under its control system,

(e) Uniting basic designs of various Users,

(f) Interpreting to Users the limitations of production facilities,

(g) Acting as technical advisors to all Services,

(h) Forming a single unit of design to contact Industry.

In the early part of 1940, a [redacted] of civilians drawn [redacted] the automotive industry was [redacted] to England to act under C.M.H.Q. on the vehicle programme. A history of their activities is written elsewhere, [redacted] "Production [redacted] Assembly of Canadian Army Vehicles in the United Kingdom [redacted] Allied Activities carried out by the Directorate of Design of Equipment and Mechanization of the Branch of the Q.M.G., Canadian Military Headquarters", dated May 24/45.

By referring to the above document, it will [redacted] seen that shortly after vehicle design in Canada was transferred from D.N.D. to D.M.&S., arrangements [redacted] made for D.D.E.M. to be [redacted] under joint authority of C.M.H.Q. and D.M.&S. (U.K.) (Sept. 1/42). D.D.E.M. was the outgrowth of the group sent over in 1940.

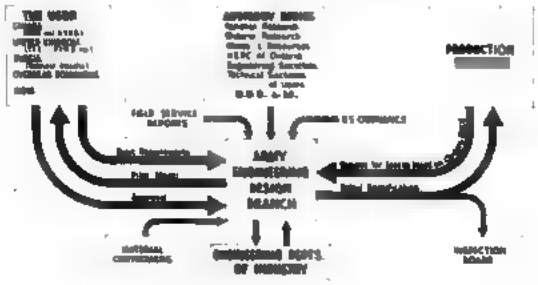
D.D.E.M. provided a very valuable service for Canadian design. It acted in direct liaison with the Canadian Army Overseas and was thus able to send back requirements, decisions and comments to A.E.D.B. The observations of its members, who were trained automotive engineers [redacted] technicians, was of great help. A further valuable service [redacted] performed in follow-up contacts for A.E.D.B., to Ministry of Supply, War Office [redacted] British manufacturers.

D.D.E.M. was in [redacted] excellent position to witness the [redacted] of Canadian vehicles. [redacted] October 22/45, it [redacted] a report "Notes [redacted] the future development of "A" and "B" Vehicles for the Canadian Army, as received at [redacted] [redacted]te of writing by Directorate of Design of Equipment and Mechanization, Canadian Military Headquarters - Dept. of Munitions and Supply."

The final report of D.D.E.M. activities [redacted] issued on November 26/45. See "Completion of Production and Assembly of Canadian Army Vehicles in the United Kingdom and other winding up operations carried out by the Directorate of Design of Equipment and Mechanisation of the Branch of the Q.M.G., Canadian Military Headquarters, 6th May to 30th November, 1945.

It [redacted] been stated that the major duty of the Branch was to produce a specification which could form part of a contract for building [redacted] acceptable vehicle. The following chart illustrates the development and provision of a specification:-

[redacted] OF [redacted] OF SPECIFICATION



The preceding chart shows:-

1. The requirement from the User being placed directly before A.E.D.B. This usually came in the form of a general description of the function the vehicle was intended to fulfil, plus [redacted] indication of the performance required. Considerable consultation usually took place through conferences or correspondence.

2. A pilot design was developed. During this development, consultation took place between User and Design. The pilot [redacted] submitted for approval.

3. Upon obtaining approval a detail Specification [redacted] drawn up.

4. After giving approval, the User placed [redacted] orders with the Production Branch. (Actually these orders generally preceded final approval, in order that production plans could proceed. These orders [redacted] usually placed as [redacted] as it was clearly indicated that the design under development would satisfactorily fill the requirement).

5. Upon receipt of the order, the Production Branch de[redacted] a Specification [redacted] A.E.D.B.

6. The Specification [redacted] issued by A.E.D.B. to the Production Branch and to the Inspection Board.

7. During the development, A.E.D.B. worked [redacted] one with the engineers of Industry.

8. Full use was [redacted]e of such advisory bodies [redacted] those listed [redacted] their facilities [redacted] research and test [redacted] utilized as necessary.

9. Field Service Reports on vehicles in the field [redacted] used to influence new designs.

10. The Canadian Automotive Industry is closely related to that of the United States. Full advantage [redacted] taken of all information available from that source. The normal contact was between the companies on each side of the border and with U.S. Ordnance, who controlled the Industry design in that country.

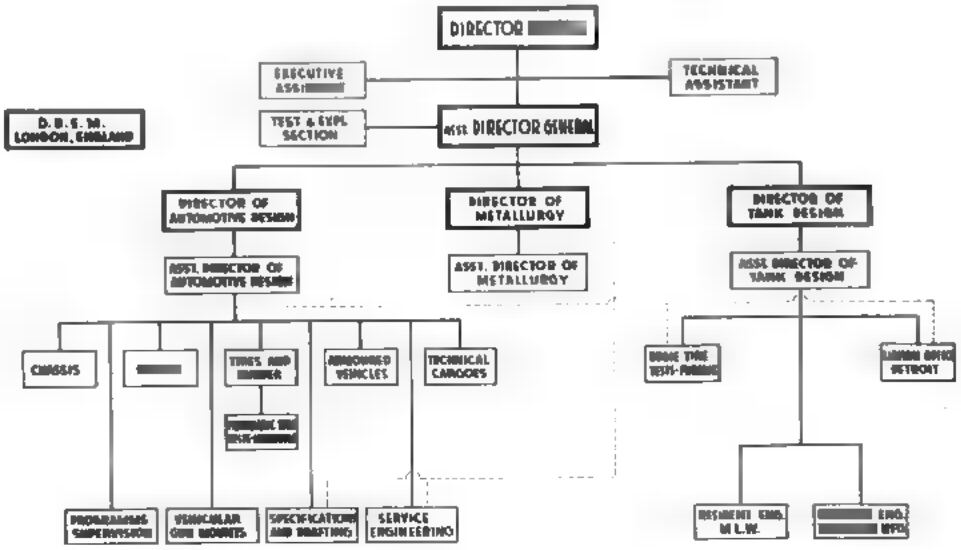
11. Due to various shortages it was [redacted] cessary for designers to work closely with Government material Controllers.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

The following chart shows the organization of A.E.D.B. in the spring of 1944. This was found to be a very elastic pattern for allotting responsibility. It could [redacted] adjusted to accommodate increases or decreases in any particular phase of the work; or could add a new function, or give up an old, without disorganizing the Branch as a whole, or any Directorate or Section:-

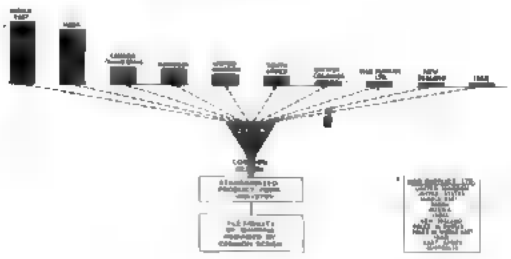
ARMY ENGINEERING DESIGN BRANCH

MARCH, 1944



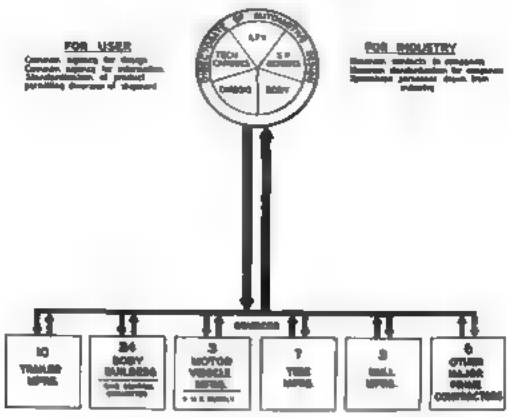
When vehicles are being provided for all corners of the earth, it is difficult to maintain uniformity of design. Each locality has certain predominating requirements as well as certain likes and dislikes. If each of these had contacted every factory directly, chaos would have resulted. Each plant would have had to produce a great many more types; the parts supply problem, already difficult, would have become impossible; storage and shipping of vehicles would have become inflexible. The following chart shows the function of the Design Branch which is intended to minimize the difficulties and dangers mentioned above. It is based on shipments during [redacted] year 1942:-

DESTINATIONS BY VOLUME
AUTOMOTIVE EQUIPMENT



The following chart might be called the [redacted] of the [redacted] on the left, inasmuch as it shows the multiplicity of [redacted] with which a User would have to deal if there [redacted] no central design agency:-

FACTORY CONTACT AUTOMOTIVE INDUSTRY



[redacted]

Within the Branch were three sections which served all design sections and directorates, namely:-

Test and Experimental,
Specification [redacted] Drafting,
Service Engineering.

The Test and Experimental Section reported directly [redacted] the Assistant Director-General. Thus, it [redacted] in a neutral position where no group charged with design could unduly influence the test findings or conclusions. Another section of this volume deals [redacted] fully with [redacted] [redacted] work itself and many reports exist on various test projects and on the test facilities.

The Specification and Service Engineering Sections were not considered to warrant, in themselves, the creation of a fourth directorate and, therefore, they [redacted] placed in the directorate of automotive design. However, they served the Branch as a whole.

Within the Specification Section was included the responsibility for [redacted] such [redacted] fuels, lubricants, hydraulic fluids, paints, etc. Thus, this [redacted] required engineering skill [redacted] beyond that which would [redacted] required to merely take care of specifications which covered design produced by another group. [redacted] detailed description of the work on fuels, lubricants, etc. will [redacted] found in this volume under the heading "Chemical Products" [redacted] the specification procedure will [redacted] [redacted] in this volume under "Specification System".

[redacted] separate chapter of this volume describes the work of the Service Engineering Section.

[redacted]

It is possible that, at sometime in the future, [redacted] question of vehicle design may arise [redacted] it would be advantageous to discuss the matter with a man who took part in design during World [redacted] II. For this [redacted] son, there are listed below [redacted] [redacted] of a few of the individuals [redacted] with this work:-

In Industry:-

Ford Motor Co. of Can.	A.D. Harris,
	E.L. Simpson,
	R.J. Renwiak,
	R. Sale,
	R. Davis.
General [redacted] [redacted] Can.	A.A. Maynard,
	E.F. Armstrong,
	F.E. Hudson,
	N.H. Daniel,
	H.W. Smith.
Chrysler Corp. [redacted] Can.	W.E. McCrew,
	W.S. Easton,
	J. Hickey,
	H. Moore.
Int'l. Harvester Co. of Can.	T.A. Rice,
	C.E. Blackburn.
[redacted] Bridge Co.	W.B. Nicol.
Tire Tech. Committee	M.H. Cryder,
	W.R. Walton.
Steel Body [redacted] Assoc.	E.S. Sargeant,
	E. Lydan.
[redacted] [redacted] Drive Co.	F. Vivian.
Montreal Locom. [redacted]	C.P. Madely.
Angus Shops	H.B. Ewen.
D.D.E.M.:-	A.S. Ellis,
	S.E. Swallow,
	H. Ronson.
Ministry of Supply:-	Maj. Gen. Brander,
	Brig. K.M.F. Hodges,
	H. Hiblitt,
	W.N.G. Phillips.

A.E.D.B.:-

Director-General	(1) R.E. Jamieson,
	(2) N.C. Millman.
Asst. Director-General	(1) H.J. Stevenson,
	(2) N.C. Millman.
Director of Tank Design	(1) Lt. Col. M. Evans,
Asst. " " " "	(2) M. Bain.
Director of Automotive Design	(1) H.J. Stevenson,
	(2) N.C. Millman.
Asst. Director of Automotive Design	(1) N.C. Millman
	(2) Lt. Col. R. L. Franklin,
	(3) S.C. McLaren.
Director of Metallurgy	- Dr. C.W. Drury.
Liaison Officer, Detroit	(1) Capt. C. Carscallen,
	(2) Capt. D. Bernhart,
	(3) Capt. R. Learmonth.
Chassis Design [redacted]	(1) S.C. McLaren,
	(2) W.M. Chater.
Body Design [redacted]ad	(1) Maj. R.L. Franklin,
	(2) R.L. Kelly,
	(3) G.E. Brook.
Tire Design Head	(1) A.A. Jansen,
	(2) Capt. W. Clarke.
Arm. Veh. Design Head	(1) Major M. Evans,
	(2) G.G. Manning.
Tech. Cargo Design Head	(1) Maj. G.F. Bradbury,
	(2) [redacted]j. G. Wright.
Veh. Gun. Mt. " "	(1) Capt. H.A. Martin.
Spec. & Drafting Super.	(1) P.B. MacEwen.
Service Engineer	(1) C.G. [redacted]z.
Programme Super.	(1) Major C.B. Deyo.
Test Supervisor	(1) C.W. Kirkpatrick.
Tech. Asst. to D.-G.	(1) Carleton Craig.
Exec. Asst. to D.-G.	(1) T. Campbell-Rogers.
Tests, Normoyle, Texas	(1) P.M. Quick,
	(2) H.C. White.
Tire Tests at Phoenix, Arizona	(1) Capt. R. Learmonth.

DESIGN CONTROL PROCEDURE

[redacted] the heading "Design Organization" a general outline is given of the development of a specification.

Following is a [redacted] detailed description of the proced[redacted] which [redacted] employed [redacted] the controls which [redacted] developed to formally regulate the activities which took place within the responsibility of the Branch.

Sincere efforts [redacted] [redacted] at all times to keep procedures [redacted] simple [redacted] possible [redacted] to avoid [redacted] unnecessary forms or paper work. However, the vehicle programs assumed such magnitude that some centralized system of control was essential. [redacted] is felt that a happy compromise was achieved which lay between a rigid red-tape system and one which [redacted]s too loose.

Authority [redacted] commencing a project [redacted] required before work started. Usually, a project originated in a request from a potential user and came in the form of a letter or cable. After A.E.D.B. had studied [redacted] request, from a design point of view, the Automotive [redacted] Tank Production Branch [redacted] consulted to determine if production facilities might be [redacted]e available.

If the [redacted] Branches agreed that the project [redacted] proceed, they collaborated in finding a pilot [redacted]e. Whenever possible, [redacted] pilot was built at a plant which might subsequently produce the volume run.

The proposed source was contacted. The suggested design was discussed. An estimate of cost was developed and the necessary funds were raised (For this procedure see "Financial", Page 1, Volume I). Formal instructions to the contractor [redacted] issued by the Purchasing Branch of D.M.&S. An informal [redacted] tentative specification was provided.

The development of the pilot, together with the preparation of drawings, then proceeded without [redacted] greater formality than that of writing letters confirming arrangements made from t[redacted] to time. The User was kept in touch with development and was consulted when necessary. Such consultation was effected by correspondence, photographs and, if possible, by personal inspection by User representatives.

During the building of the pilot, the specifications and drawings were prepared. Tests by the contractor [redacted] applied where possible.

PILOT MODEL APPROVAL

Upon completion, the pilot was inspected by representatives of the User. Any modifications called for as a result of the inspection were put into effect and a Pilot Model Approval form was issued. This document was the official notification to the Production Branch that a design existed upon which material and manufacturing commitments might be made. Interim or partial Pilot Model Approvals were often issued in order to authorize the Production Branch to [redacted]e manufacturing commitments on certain components before the vehicle as a whole was released.

SPECIFICATION

The Specification [redacted] released in its finished form at this time and it [redacted]came a key factor in the production contract. Drawings [redacted] considered to form a supplementary part of a specification. In each specification the attempt was made to place clearly before industry the requirement of the User; but the attempt was [redacted]lso made to avoid detail which [redacted]uld prevent a contractor's designers using their own initiative, or which would prevent consideration of components for which tooling already existed.

The original Specification was com[redacted]pleted and duplicated by the Army Engineering Design Branch and issued in [redacted] required number of copies to the Inspection Board of the United Kingdom and Canada, who were responsible for its distribution to the Contractors, Inspecting Officers, and the User services.

DESIGN CHANGE NOTICE AND DEVIATION PERMIT

Once a specification had been issued and used as a basis of one or more contracts, it became necessary to issue [redacted] amendment to it in a form which constituted a firm commitment. A great [redacted] organizations were concer[redacted] in [redacted] change to [redacted] specification, for example:- Contractor, Inspection, Financial, User, etc. A system was, therefore, developed known as the Design Change Notice procedure (see Standard Procedure No. 9 issued by the Automotive and Tank Production and the Army Engineering Design Branches. This procedure seemed to have the correct combination [redacted] elasticity and specific statement required to permit application to a broad range of items. The soundest proof [redacted] its [redacted] [redacted] the objection raised by several organizations [redacted] it [redacted] proposed, [redacted] [redacted], to restrict its scope. This procedure operated as follows:-

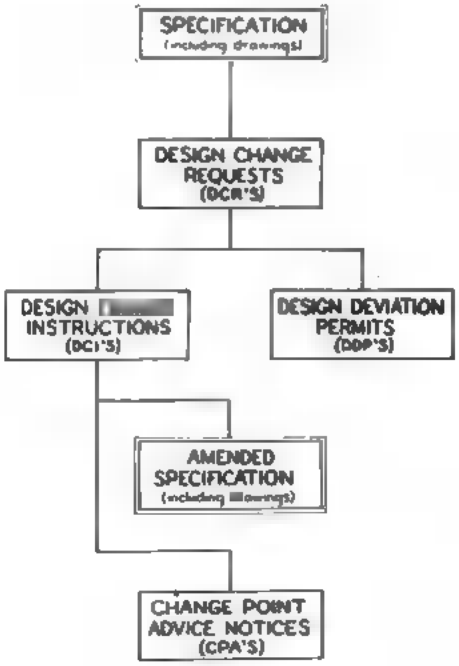
Following issuance of [redacted] approved specification, any subsequent modification [redacted] authorized by a Design Change Instruction (DCI), where the change was to be permanent, or by a Design Deviation Permit (DDP), where the change [redacted] of a temporary nature only.

DESIGN CHANGE REQUEST

Requests for changes originated from Contractors, the Inspecting Authorities and the Users. R[redacted]equests were submitted to Army Engineering Design Br[redacted]anch on Design Change Request forms. After the request had [redacted] approved by the [redacted]gn Engineer, it [redacted] submitted to [redacted] Production Branch for approval, then to the Director of Design who authorized the issue of a D.C.I. [redacted] D.D.P., whichever [redacted] applicable.

Periodically, specifications [redacted] amended to incorporate revisions authorised by D.C.I.'s. The revised specification carried a cross-refere[redacted] to the authorizing D.C.I.'s which enabled [redacted] Inspecting Authorities to determine, by reference to the D.C.I., when the amended specification [redacted] effective in production. Drawings originated by Army Engineering Design Branch, when amended, carried a cross-reference in the revision column to the authorizing D.C.I.'s.

D.C.I.'s and D.D.P.'s carried cross-reference to the D.C.N.'s so that the origin and reason for [redacted] change could be traced.



The Inspecting Authorities would not pass units deviating from the existing specification until they were in receipt of a D.C.I. or D.D.P. authorizing the change.

Where a change affected cost, the Contractor referred to the D.C.I. when applying for a price adjustment.

CHANGE POINT ADVICE NOTICES.

After a change had been incorporated into production, the contractor recorded the serial number, of the first unit in which the change had been incorporated, on a copy of the applicable D.C.I. (or D.D.P.) and returned it to the Army Engineering Design Branch. Periodically, these serial number reports were compiled on Change Point Advice Notices which were distributed to interested Government Agencies and to the Users. These Change Points were recorded also on the master file copies of the D.C.I.'s (or D.D.P.'s).

There were several instances where the above procedures did not apply, these were as follows:-

1. When vehicles were purchased in the United States, Standard Procedure A.E.D.-8 applied.

2. Where vehicles were purchased for the Research Enterprises Limited, Standard Procedure A.E.D.-10 applied.

3. Where vehicles were purchased by a Dominion, in Completely Knockdown (C.K.D.) state, through the overseas subsidiary of the Canadian company. In these instances, the design arrangements were made by the overseas Dominion with the Canadian company through the overseas subsidiary, and Standard Procedure No. 21 issued by the Automotive and Tank Production and Army Engineering Design Branches applied.

ORDERS

Subsequent to the original release of a specification, and after it has been used as a basis of an original contract, the specification might be used time and again for later orders. Nearly all specifications included options to be applied at the discretion of the user (e.g., tire size, body, etc.). Also certain types of equipment were not suitable for certain operational theatres.

In the early stages of the organization, some difficulties and confusion existed, because of lack of detailed knowledge on the part of the Production Branch of the specification variations applicable to individual orders. This was overcome by developing the following forms and procedure:-

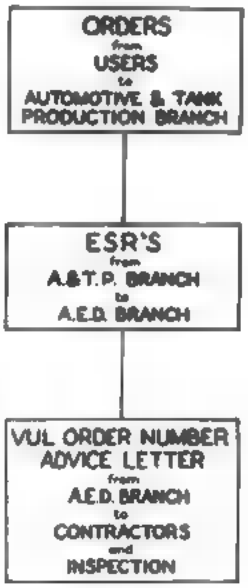
E.S.R.'s

Orders were received from the Users by the Automotive and Tank Production Branch. Following receipt of the orders, the Automotive and Tank Production Branch submitted Engineering Specification Requests (ESR's) to the Army Engineering Design Branch and, concurrently, requisitions to the Purchasing Branches who submitted tenders to Contractors. The Tenders did not include any specification but carried the stipulation that the units were "to be in accordance with specifications developed by the Army Engineering Design Branch".

V.U.L.'s

Upon receipt of the E.S.R., the Army Engineering Design Branch determined the type of unit which would meet the requirements of the order and compiled a Vehicle Unit List (VUL) showing the combination of chassis, body and equipment. "Standing" VUL's were developed for standard models so that where the same or this type, a system of delay occurred in allocating a VUL number. The VUL number for MT vehicles was the vehicle was stamped on the vehicle serial number plate. (For reference to codes and their application see Specification O.A. 85). The VUL covered the combination of chassis, body and equipment by reference (a) to the specification covering the basic chassis and cab, (b) to the schedule of drawings covering the body and (c) the individual drawings and specifications for the various items of equipment. After the VUL number had been determined, the Army Engineering Design Branch issued a "VUL Number Advice" letter to the contractor with copies to the Inspection Board and the Production Branch. This established the Specifications and related drawings which formed part of the contract for that order.

Standard Procedure A.E.D.-5 was issued to cover the detail procedure to be followed in issuing VUL's for vehicle orders.



DRAFTING PROCEDURE

The Drafting Staff was established under to provide a service to all design sections of the Branch. This arrangement was desirable so that the available staff could be employed at maximum efficiency as the drafting requirements for each individual design section varied considerably from time to time. This had the additional advantage of ensuring a uniformity in the preparation of the drawings and in the information issued.

A procedure was established of providing a schedule of drawings for each individual project. The schedules were, in effect, the parts list or bill of material and an index list of all the drawings comprising the project. The drawings were listed on the schedule in relation to the assembly or sub-assembly of which they formed a part. The schedule was supported by a Drawing Control Sheet on which the drawings were listed in numerical order and the current date of each drawing recorded. This drawing control sheet was revised at monthly intervals in order to give the Inspecting Officers and the Contractors a means of definitely determing if their drawings were current.

As the Branch organization grew, it became necessary to increase the drafting correspondingly. The larger staff on the drafting staff resulted in a need for establishing a procedure of control to ensure that each design section would receive its fair share of

available personnel. This was accomplished byinstituting a drawing order requisition form and by allocating order numbers for each section. In this way, it was possible for each section to indicate the priority of its drawing orders on hand. The drafting room issued a report twice a month of the status of drawing orders received. This report gave all a picture of the drafting progress enabled the Director todetermine the drawing order priority the various design sections. In this way, draftsmen were allocated to the projects of the various design sections in accordance with the urgency of individual projects in relation to the total work on hand.

However, the drafting requirements were greater than could be handled bythe drafting staff of the Branch as it was impossible to obtain a sufficientnumber of qualified personnel, it was necessary to have a large part of the drawing requirements done by Contractors. This arrangement necessitated instructing these contractors in our drafting room procedure so that the drawings made by them could be absorbed into our files and issued as if they had been prepared by our own staff. Standard Procedure No. AED-3 was issued as a guide to contractors in the preparation of these drawings. This was supplemented by periodic visits of two senior draftsmen to the Contractor's plants to check the drawings they had prepared for accuracy and procedure.

After the drawings been prepared and a schedule compiled, a "Drawing and Part Release" was prepared for each individual drawing. One copy was forwarded to the Inspection Board, one copy was filed numerically and one copy alphabetically. This form gave cross-reference to the D.C.I. releasing the part; to the drawing schedule (or schedules) of which it was a part, etc. Any subsequent amendment to the drawing was recorded on a "Drawing and Part Change" form. This gave a cross-reference to the D.C.I. authorizing the change, the reason for the change, etc. One copy was forwarded to the Inspection Board and one copy was filed with the numerical file of the "Release" form.

FINANCIAL

DEVELOPMENT EXPENSE

Substantial amounts were spent on pilot development, tests and allied work. The systems described below were those in use, at the end of hostilities, for obtaining funds and controlling expenditure.

I. Funds for Pilots built on order from D.N.D.

A procedure was authorised by interchange of correspondence between Deputy Ministers of D.M.&S. and D.N.D. (Army) dated 25/44 and April 8/44 respectively, (D.M.&S. File 73-1-225).

By this procedure, D.N.D. issued a Contract Demand following which D.M.&S. issued an MSX requisition (Form No. MS 314) charging FE. 1492. After delivery of pilot to A.E.D.B., the latter certified receipt thus allowing payment to contractor by D.M.&S. Subsequently, when A.E.D.B. had completed tests, had received pilot model approval from D.N.D. and had made delivery to D.N.D., a charge was made from D.M.&S. to D.N.D.

II. Funds for Pilots other than those resulting from order placed by N.D.H.Q.

A Financial Encumbrance No. FE. 1564 (903) was authorised to provide funds for development and test work not covered by the D.N.D. Contract Demands mentioned above. In this class, the major portion was required for:-

1. Development of Designs for U.K.,
2. Major tests such as cold starting and conversion to synthetic rubber tires,
3. Developments originating in A.E.D.B. (e.g. improved ambulance ride, lightweight bodies, improvements to design of existing vehicles, C.D.P. track).

III. Funds for Test and Experimental Section of A.E.D.B.

The functions and methods, other than financial, of this section are described in a separate chapter of this volume. The finances were handled in three categories, as follows:-

(a) Contract with Patterson Motors Ltd., Ottawa, for provision of garage and labor facilities,

(b) Fuel, lubricants, etc. (FE.1564 (903)),

(c) A revolving fund (FE. 2239) which permitted the purchase of vehicles from D.N.D., and which could be credited with a portion of the cost of any such vehicles accepted back by D.N.D. or which could be credited with any return from War Assets resulting from the sale of equipment within this category.

IV. Control.

Within the Branch:-

When the head of a Design Section of the Branch wished to initiate a project, he submitted the proposal to his director, giving at the time, the basis of the requirement (e.g. request from U.K.) and an estimate of the cost. If the director concurred, he in turn, submitted the following two documents, re finances, to the Director-General:-

(1) A Branch internal statement of cost requesting that the required funds be allocated from FE.1564 (903), and frozen, to be thus available to meet subsequent incoming invoices.

(2) A M & S Requisitions (Form # 314) for delivery to the Purchasing Branch, for work by one or more contractors.

A constant endeavour was made to keep close watch on the expense increase as the project progressed. This enabled questions to be raised while the problem was still current; it also made it possible for additional funds to be allotted, if necessary, before the receipt of invoices. It was realized that it is often extremely difficult to forecast experimental and development expenses accurately, as sometimes an original line of attack may have to be almost completely scrapped, and also because the User often alters his requirements radically as development progresses or visualized or field conditions change.

Within the Branch, a record was kept against each project. This record noted the funds allotted (original plus any additions or other alterations), requisitions issued, invoices received and balance of allotment. From this, a monthly statement was prepared and delivered to the Comptroller of the Department.

By this method, individual projects could be scrutinised as the status, as a whole, of the amount covered by the F.E. was known at all times.

A record was kept of receipt and final disposition of articles purchased. In the main, the disposition might be divided into four classes:-

(1) Expendable (fuels, lubricants, etc.),

(2) Worn out in test (tires, vehicle components, etc.),

(3) Delivered to User (Pilot Models, etc.),

(4) Declared Surplus (items turned over to War Assets at close of hostilities).

Information may be found on the detail of purchases of the preceding nature by referring to the M. & S. Requisition series file which was the prefix "MSX-134". A.D.M.&S. Central Registry file is allotted to it.

One very important purchasing arrangement was authorized which permitted A.E.D.B. to designate, on the M.S. requisition, the source to be approached. This arrangement was necessary for several reasons, chief of which were:-

All User design requirements were coupled with an urgent plea for haste,

Pilot development could only be placed on a cost plus basis because no design existed upon which a tender could be based,

The components required were often the product of one contractor,

Practically all contractors were working to capacity on government work and an added pilot merely changed the type of a certain portion of that work.

A.E.D.B. knew best which contractors had the best design and pilot building facilities for various types of projects.

TRAVELLING

As travelling represented a sizeable proportion of the controllable expense of the Branch, probably some mention of it should be made.

Outside design sources and Pilot contractors were almost all located outside Ottawa. The majority were in or adjacent to Montreal, Oshawa, Toronto, Hamilton, Kitchener and Windsor, but some were as far away as Vancouver. On account of these widely spread contacts, a very considerable amount of travelling became necessary.

Speed of development took priority over everything else. A constant race against time continued throughout the war. Great reduction in time of development could be made by sending men to provide information, to make

decisions, [illegible] to see that efforts were kept going at top speed. The drafting facilities of our smaller sources were limited and required supplementing from A.E.D.B.staff, particularly in the way of periodic supervision.

Numerous contacts werenecessary with such bodies as U.S. Ordnance, Society of Automotive Engineers, U.S. contractors.

Major tests took place in Texas, Arizona, Manitoba, Northern Ontario, British Columbia.

Visits were made to Users in England and the Continent.

As a result of the above, travelling expenses [illegible] high in relation to those of [illegible] other Branches. However, the expense was small in relation to the expediting of work which it accomplished. A contract cannot be let until a specification is available and, since in the [illegible] of vehicles, the contract usually represented large volume, as short a time as one week [illegible] of vital importance.

CHANNELS OF COMMUNICATION

[illegible] channels of communication, through which [illegible] organization works, are obviously all-important.

The number of Users, Contractors, Consultative Bodies and others with whom the Army Engineering Design Branch maintained contact, was very large.

In the main, the channels to the Users, which were open to A.E.D.B. were reasonably direct. However, appreciable time was spent in organizing to assure efficient contact. These were, generally speaking, as follows:-

CANADIAN ARMY

(a) N.D.H.Q.

Direct contact with the M.D.O. Branch on requirement and acceptance was maintained first through D.of Mech. and later through D.D.V.& S.A. Through these Directorates A.E.D.B. discussed requirements directly with user corps and groups such as armoured formations, Artillery, Engineers, Medicals, R.C.A.S.C., etc., as well as with D.S.D.(W). Maintenance matters and vehicle performance in the field were discussed directly with R.C.E.M.E.

(b) C.M.H.Q.

Liaison was through the D.D.E.M. group in London (Directorate of Design, Equipment and Mechanization). This civilian organization, placed in London in the early part of the war, obtained decisions as required from C.M.H.Q., and indicated requirements which were subsequently discussed between N.D.H.Q. and A.E.D.B. D.D.E.M. served as parts of both H.M.H.Q. and D.M.& S. Incidentally, they served a most useful function in following up items for A.E.D.B. with Ministry of Supply [illegible] British industry.

UNITED KINGDOM

All direct contact was through Ministry of Supply. For 'A' vehicles it was through [illegible]; and for 'B' vehicles with TT2. Both these organizations made it possible for A.E.D.B. to hold discussions with War Office when appropriate. Considering the distance they were apart, the success with which these bodies and A.E.D.B. co-operate is really remarkable. While two or three visits had been made on specific projects by individuals connected with those projects, no visit of a general type [illegible] made by an A.E.D.B. representative until 1944. At that time the Director of Automotive Design visited England following a request which had [illegible] by TT2. The results [illegible] possible by this visit in the way of closer liaison with those with whom we were working, and in the [illegible] of obtaining clearer requirements, definitely demonstrated that it would have been of great value had such visits by A.E.D.B. senior personnel been [illegible] fairly frequently starting from [illegible] beginning.

Arrangements were made, with the N.O.S. representative for North America, that a reasonably direct contact was maintained with R.E.M.E. officers in the country on vehicle-maintenance problems.

[illegible]

Through the commercial attaché of the embassy, discussions [illegible] held with military representatives on individual projects as the need arose.

INDIA

The arrangement was never entirely satisfactory. Considering [illegible] huge quantity of vehicles shipped to India the contact should have been much closer. Requirements were received chiefly through British Ministry of Supply. The only recurring direct liaison was with the North American technical representative of the Indian Army.

In the last year of the war visits were made by members of India M.G.O. staff who [illegible] keen to develop a closer working arrangement.

India received a large proportion of her vehicles in C.K.D. form and much of the detail design modification [illegible] arranged by India with the local Ford or G.M. assembly plant who in turn made arrangements direct with the [illegible] pending Canadian factory. While this worked out quite well, it was not entirely satisfactory for two reasons:-

(1) A specification is necessary as part of a contract. A.E.D.B. was called upon to supply this specification but on account of the inter-plant arrangements mentioned above, it acted on a "rubber stamp" basis to a degree beyond that which is desirable.

(2) Ministry of Supply was not entirely happy because standardization of vehicles was somewhat affected.

AUSTRALIA

Official contact was through the High Commissioner's office, but detail contact varied somewhat. The [illegible] C.K.D. arrangements held with Australia as with India, and had the same shortcomings.

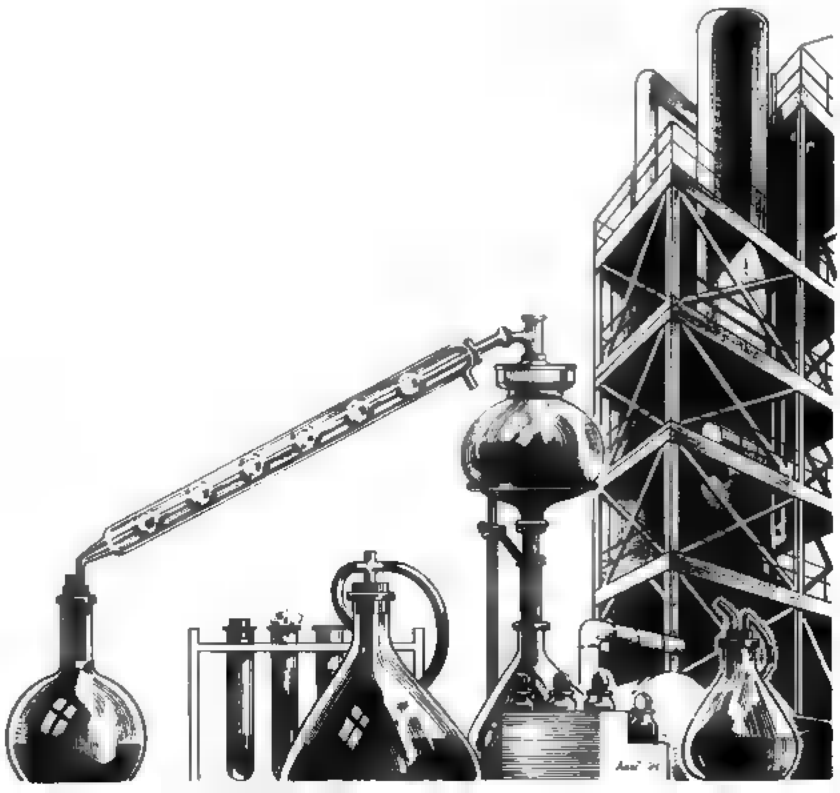
UNITED STATES

No contact of any moment [illegible] necessary in her role as a supplier and in working on common projects. At first this was done directly between Ottawa and either Washington or Detroit. Later, at the suggestion of U.S. Ordnance, A.E.D.B. placed a liaison officer in Detroit to the great advantage of the work. This officer obtained necessary information as required; kept A.E.D.B. posted on U.S. design matters and arranged for visits between officials of the two countries. The common projects are represented in the main by the cold weather trials which [illegible] run in Canada and by the tire tests which were operated in the U.S.

It is well to record here that A.E.D.B. always enjoyed most cordial working arrangements with the U.S. Army. Naturally [illegible] was taken to assure this situation.

Contacts with U.S. contractors [illegible] arranged through Detroit, as and when required.

CHEMICAL PRODUCTS



FUELS, LUBRICANTS & HYDRAULIC FLUIDS

The vital importance of mechanically self-propelled vehicles in modern warfare is universally recognized. They cannot be moved without fuels and lubricants, thus these products are of equal vital importance. One of the major problems of World War II was the supply of petroleum products. It has been authoritatively reported for instance that petroleum products constituted over 60% of the total tonnage moved into Africa for the Libyan campaign.

In addition to the problem of supplying the army with the necessary quantities of petroleum products there has also been the difficulty of providing the proper types. The demand for a large number of different types of fuels, lubricants and hydraulic fluids immensely complicates the problem of supply. The ideal situation would be where all ground forces were able to use mechanical equipment which could be serviced with the same fuel, the same lubricating oil, the same lubricating grease and the same hydraulic fluid. This ideal was not achieved in World War II.

Climatic conditions alter the requirements of all petroleum products and further complicate the supply situation, particularly where it is necessary to divert shipments for strategic reasons. In World War II, shipments of winter grade gasoline destined for Northern Russia had to be diverted to North Africa and very serious difficulties were experienced due to its high vapour pressure causing fuel vapour lock in the high temperatures encountered there. The ideal would be to have mechanical equipment so designed that it could operate on the same petroleum products irrespective of the climatic conditions. This ideal was not achieved in World War II.

At the beginning of the war, one of the difficulties encountered was the variation in lubricant recommendations by different manufacturers for equivalent or similar items of equipment. An example of this problem was the difficulty of getting Ford and General Motors to agree on lubricant recommendations for inclusion in a combined maintenance manual prepared for Canadian Military Pattern vehicles manufactured by these two companies. More time was involved in reaching agreement on this item than on all the mechanical portion of the manual. Many manufacturers were accustomed to specifying branded products and were reluctant to agree that a product supplied to any Army Specification would do a satisfactory job.

In the preparation of instruction manuals for the British and Canadian Armies difficulty was experienced in listing lubricant recommendations which both Armies recognized and agreed upon, as an added difficulty nomenclatures were not the same; also certain lubricants needed for successful operation of Canadian vehicles, such as hypoid gear oils, were not carried by the British Army prior to the war. With the entrance of the United States into the war, problems of this kind were greatly increased.

A continuation of the condition, where individual vehicle manufacturer's standard specifications were recommended and followed and where each army carried products to its own specifications, would have resulted in a complicated field supply situation as illustrated graphically below.

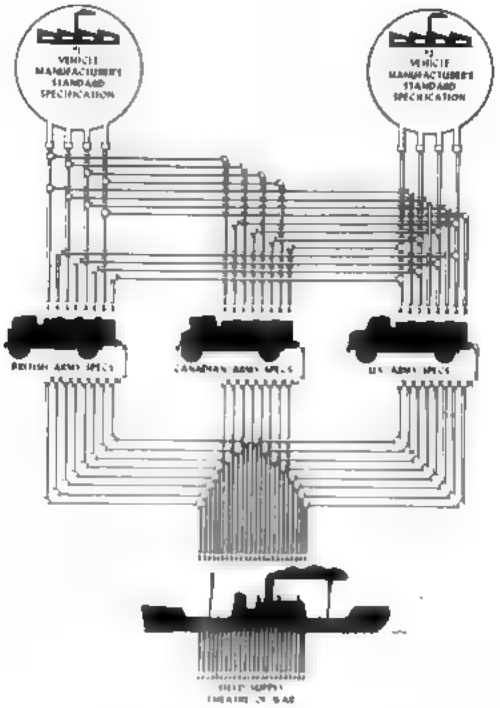
The possibility of such a complicated supply situation indicated the urgency of some standardization. In May 1942, therefore, a meeting was held in Washington between British and U.S. representatives and an agreement was concluded to standardize the following items for general field supply for combat areas -

(i) One grade of Diesel Fuel.
(ii) One grade of Gasoline.
(iii) Three grades of Heavy Duty Engine Oil.
(iv) Two grades of Hypoid Gear Oil.
(v) Five grades of Grease.

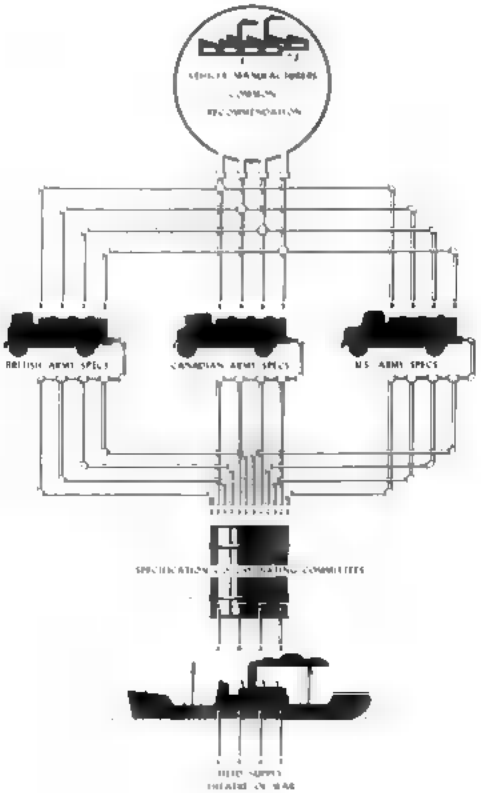
Other specialized products were to be carried, in addition, in Ordnance Workshops.

Following the Washington meeting the Canadian Army accepted the programme agreed upon by the British and U.S. representatives.

Subsequently arrangements were made to adopt a uniform nomenclature and method of identifying products. Following this vehicle manufacturers were instructed to list the standardized symbols in their manuals and in this way the recommended lubricants were universally recognized.

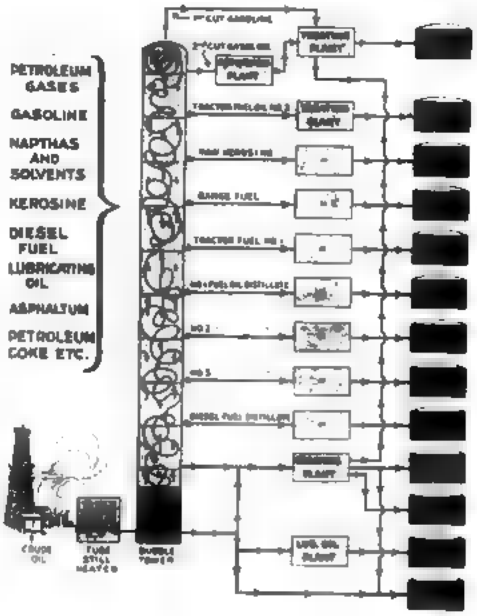


This overall arrangement resulted in a simplified field supply situation as illustrated graphically below.



A COMPOSITE FLOW DIAGRAM

OF A MODERN REFINERY



Although this general agreement was a big step in the right direction many individual problems remained to be solved. In their solution the advice and active help of the National Research Council Associate Committee on Petroleum proved of great assistance. These individual problems are discussed in more detail hereunder.

FUELS

As previously stated, the ideal would be to have all the engines of ground vehicles so designed that one fuel only would be required. In World War II the preponderance of engines were of the gasoline type, but many diesel engines were also used. This necessitated the supply of at least two fuels. At the start of the war [redacted] Tanks used adapted Aviation engines which required high octane aviation gasoline. Shortly after the start of the war all gasoline in the U.K. was pooled and, in order to conserve supplies of tetra-ethyl lead, a lower octane number fuel was used in MT vehicles than in Armoured vehicles. Thus, shortly after the start of the war the following fuels were available in the U.K.

(i) One grade of Diesel Fuel.
(ii) 68 octane gasoline (unleaded) for MT vehicles.
(iii) 75 octane gasoline (leaded) for use in Armoured vehicles.
(iv) 87 octane aviation gasoline (leaded) for use in Radial Tank engines.

Following entry of the U. S. into the [redacted], further standardization of fuels was achieved by modification of the Radial Tank engine, with some HP loss, to use an 80 octane [redacted] gasoline. This had the added important advantage to the U.K. of conserving vital aviation fuels. At the same [redacted] a decision was made to supply only the 80 octane (highly leaded) gasoline for all [redacted] vehicles. This standardization, while obviously good in itself, resulted in a number of new problems. Among these were:-

(a) Starting difficulties were encountered on the [redacted]ial Tank engine due to the different distillation curves of the MT and aviation gasolines. This difficulty was later [redacted] by carburettor and primer revisions.

(b) The adoption of highly leaded gasolines for all [redacted] vehicles resulted in serious valve troubles [redacted] many British vehicle engines [redacted] also on [redacted] U.S. and Canadian manufactured auxiliary engines. An intensive study of the problems involved required a major redesign of some engines with improved valve materials the important change. It was found also that more careful valve maintenance [redacted] greater exhaust valve clearance and higher operating temperatures improved the valve life.

(c) [redacted] first theatre of war to come into prominence was North Africa where high temperatures were encountered and some difficulty was experienced with vapour lock. As most of the gasoline supplies originated from the U. S. their Army Specification No.2-105 was used to govern supplies and it was revised to overcome difficulties encountered. It [redacted] not found practical to supply one fuel for all temperature [redacted]eas although this ideal was approached by U.S.Army Specification No. 2-103B which covered two types of [redacted] octane gasoline, Type A named "All Purpose" for all areas except those considered "Arctic", for which Type C was supplied.

Although [redacted] 80 All Purpose fuel was the only fuel supplied [redacted] bulk in combat areas at the end of the war, certain supply arrangements were [redacted] in the U.K. to conserve tetra-ethyl lead and the following grades were established for [redacted] there:

(i) 72 octane number for "B" vehicles and Carriers and for commercial vehicles.
(ii) 80 octane for all "A" vehicles except Carriers.
(iii) Petroleum spirit (unleaded) for -
Catalytic heaters
Generating sets and Charging sets
Small Pumping sets
Outboard engines and Charging sets

Note: This fuel was supplied by the British in 4 gallon tins for these units in combat areas also.

The U. S. Army used MT 80 All Purpose fuel entirely in combat areas but in training camps in the Continental United States 72 octane fuel was used for Transport vehicles.

In Canada commercially available fuels were used in all training camps. 80 octane aviation fuel was used for Tank and Snowmobile engines which were specifically designed for a fuel of [redacted] octane number minimum. However, for experimental test work [redacted] the Motor Vehicle Manufacturers [redacted] at the proving Ground establishment in Ottawa an [redacted] octane fuel with exactly [redacted] cos of tetra-ethyl lead per U. S. gallon was used.

In the development program for Arctic operation at Camp Shilo in 1942 - 1943 and in test work carried out in Cold Rooms under Canadian Direction fuel to U. S. Army Specification 2-103B Type A was used and satisfactory starting obtained where the vehicles were fitted with special ancillary equipment. Therefore it was possible to operate in all areas with the one All Purpose gasoline provided vehicles were specially equipped, but starting in Arctic conditions can be immensely facilitated by the use of the Arctic type fuel.

REFERENCES

File 73-F-1.
Section VIII of Part III of Specification O.A. 65.
Part IV of Specification O.A. 65.
Specification O.A. 216.
Report on Kapuskasing Cold Weather Tests 1942.
Report on Camp Shilo Tests 1942-3.

[redacted] - continued

Report E-402 - Effect of high leaded gasoline on valve life.
Report E-493 - Tests on Homelite Generator Engines.
Report E-419 - Life Tests on Homelite Generator Engine.
Report E-317 - Cold Starting Tests Sexton 25 Pdr. S.P.
Report E-318 - Cold Starting R-975-C1 Engine.
Report E-465 - Cold Starting Tests on Snowmobile Armoured [redacted] I.
N. R. C. Reports [redacted] ME-132 - Operating Life of 300 Watt Chore Horse Engine on Leaded Gasoline.

LUBRICATING OILS

As mentioned previously it would be ideal if one lubricating oil would satisfy [redacted] requirements of all mechanical equipment used by the ground forces. This ideal was [redacted] approached, although after the British-U.S. meeting in the spring of 1942 the general supply situation was greatly simplified by the decision to carry two grades of engine oil [redacted] one grade of gear oil under any [redacted] temperature area.

At the start of the war there were widely divergent recommendations in manufacturers maintenance manuals, also British and American practise varied considerably in many instances. For the purpose of [redacted] detailed discussion, lubricating oil problems are subdivided into those required for engines and those required for gearing.

ENGINE OILS

Prior to the war, commercial practice was to use straight mineral oil for most automotive engines, detergent oils for [redacted] Diesel engines and aviation engine oils for air cooled engines. There was a trend in the U. S. to use oils with oxidation inhibitors for engines with copper lead bearings in heavy duty service. One such type engine was introduced into Canadian production with the adaption of the G. M. C.-270 engine for certain Canadian manufactured vehicles.

Two to three years prior to the start of the war certain of the Automotive Manufacturers and oil refiners had co-operated in the development of an engine oil combining [redacted] detergent qualities of the Diesel oils and the oxidation inhibiting qualities demanded for engines fitted with copper lead bearings. As the development of this oil was initiated to provide lubrication for engines in [redacted]vy duty service these oils were named "Heavy Duty". Oils of this type had to meet the engine tests of the Caterpillar Diesel for detergency and of the G. M. Diesel for oxidation inhibiting and film strength.

Following the Washington meeting in May 1942 a decision was made to standardize on Heavy Duty type oils to U.S. Ordnance Specification 2-104 for the U.S., British and Canadian Armies. This simplified [redacted] problem of supply tremendously although it was necessary to carry two grades for any one season as follows:-

Winter

S.A.E.10 for all liquid cooled engines.
S.A.E.30 for all air cooled engines.

Summer

S.A.E.30 for all liquid cooled engines.
S.A.E.50 for all air cooled engines.

The adoption of Heavy Duty oils [redacted] made with little resistance but the following operational factors required investigation -

[redacted] to the detergent nature of the Heavy duty oils, specific and detailed instructions had to be issued to cover the change from straight mineral oils. Unless these instructions were followed closely, trouble was encountered [redacted] plugged oil lines etc. Following the change to Heavy Duty oils many reports [redacted] received of low oil pressure and of high oil consumption on engines which had previously used straight mineral oils. This, in the final analysis, did not prove serious.

The change to Heavy Duty oils [redacted] situated a study of the Oil Filters used. Clay type oil filters removed the additives in Heavy Duty oils [redacted] to be replaced with other suitable types. [redacted] chemically treated filters partially neutralized the effect of the additives [redacted] had to be avoided.

The question [redacted] as to the suitability of Heavy Duty oils for cold weather operation. Cold Test trials conducted at Kapuskasing in the early part of 1942 indicated that gasoline dilution of the oil was necessary to facilitate starting. Straight mineral oils [redacted] used for these tests and some doubt was expressed [redacted] whether Heavy Duty oils would [redacted] deteriorated by repeated dilution. Tests carried out by the oil companies and at Shilo proved that dilution had no detrimental effect on Heavy Duty oils. [redacted] tests did reveal the fact, however, that oils refined from certain [redacted] would not [redacted] spond to dilution unless [redacted] point depressants were present. Specifications for S.A.E. 10 [redacted] 30 grade Heavy Duty oils [redacted] revised to include [redacted] requirement of a "Pour point of minus 40°F maximum" after dilution with 20 percent Precipitation Naptha.

Difficulty was experienced with [redacted]sive foaming, particularly with the S.A.E.30 grade used in air cooled engines, which resulted in excessive oil consumption and lack of proper lubrication. Specifications [redacted] revised to add a clause stipulating foaming limits.

Spark plug troubles were experienced on some 2 cycle gasoline engines reportedly due to the additives in the Heavy Duty oils shorting the plugs. These engines [redacted] lubricated by adding the oil to the gasoline. The U.S. Army considered this difficulty sufficiently serious [redacted] specify straight mineral oil for this purpose. However test work carried out in Canada did not indicate the trouble to be sufficiently serious as to require a change in issued instructions.

REFERENCES

File 73-1-16.
U.S. Army Specification 2-104B.
D.N.D. Specifications 345, 365 and 395, Section XVIII of Part III Specification C.A. 65.
Report E-282 Heavy Duty Engine Oil and Filter Tests - Texas.
Report E-493 Mineral and H. D. oils in Homelite Engines.
D.N.D. Report on Camp Shilo Cold Tests 1942-3.

GEAR OILS

At the start of the war gear oil [redacted] mendations presented a confused picture. Manufacturer's recommendations varied considerably for similar components and in many instances recommended branded products. The British Army carried a 10% [redacted] seed oil as their standard gear lubricant but with the introduction of Canadian Manufactured vehicles with hypoid axles they had to add hypoid oils.

Shortly after the start of the [redacted] a move was made in Canada to get Canadian Manufacturers to agree on hypoid oils for steering gears, transmissions, transfer cases and differentials. The originally designed transfer [redacted] operated [redacted] such a high temperature that [redacted] aviation engine quality oil [redacted] needed for adequate lubrication. Revisions in design were introduced and eventually a transfer [redacted] was produced which operated satisfactorily on hypoid oils.

Hypoid oils were found unsatisfactory for controlled differentials and for some other components, such as final drives of Tanks, where high temperatures were frequently experienced. For these units it [redacted] determined that H. D. engine oils of the grade specified for the engine were satisfactory.

Reports were received that differently compounded hypoid oils were not miscible but an investigation carried out in Canada indicated that all of the "approved" hypoid oils were miscible.

Following the Washington meeting in May 1942 it was agreed to standardize on Hypoid gear oil for temperature areas above 0°F and on Hypoid 80 gear oil for temperature areas below 0°F.

Cold test work carried out at Kapuskasing in the early part of 1942 and at Camp Shilo in the winter of 1942-3 indicated that S.A.E.-80 gear oil was too heavy at temperatures below minus 20°F unless it was diluted with kerosene or gasoline. Diluting the hypoid oil tends to weaken its hypoid load bearing qualities but no trouble was experienced in the test work due to this.

Following the U.S. Army trials at Camp Shilo, U.S.Ordnance developed a low temperature gear oil which was tested the following winter on the Alaska Highway and proved adequate although some slight leakage difficulties developed. Following these trials U.S. Ordnance issued Specification 2-105A to cover the three grades of hypoid oil, S.A.E.-90,S.A.E.-80 and the new low temperature oil designated "75".

Prior to the war commercial practise in the heavier vehicles was to specify S.A.E.-140 gear oil for summer use. With the standardization of S. A. E.-90 for summer many complaints of leakage were reported. U.S. Ordnance carried out extensive investigations and determined that when the heavier gear oil (S.A.E.-140)was used a higher operating temperature was experienced than when the S.A.E.-90 was used,with the result that the operating viscosity was about the same. The conclusion was reached that the leakage occurred because of mechanical shortcomings.

For post war development it is recommended that an effort should be made to determine if a gear oil similar to U. S. Army "75" could be adapted for year around use. Difficulties of sealing this oil at higher temperatures might be bothersome. However, it is particularly difficult to change the oil in the steering gear and if the lighter gear oil proved satisfactory it would ensure that the vehicle would be satisfactory for use in all temperature areas.

REFERENCES

File 73-1-16.
D.N.D. Specification 390 and 360.
U.S. Army Specification 2-105A.
Report on Kapuskasing Cold Tests.
Report on Camp Shilo Cold Tests.
Report E-43 Lubrication of Universal Carrier Steering Gear.
Report E-416 Snowmobile,Armoured,Tracked I Driving Member Gear Lubricant Trials.
Specification O. A. Part III, Section XVIII.
Specification O. A. 216.

GREASES

At the start of the war a similar condition existed with respect to greases as for gear oils,that is manufacturer's recommendations varied, considerably for similar applications.

Following the Washington meeting mentioned previously the British agreed to adapt the U. S. Army grease specifications and to carry in general supply the following grades -

(i) General Purpose #0 for chassis lubrication for low temperatures.

(ii) General Purpose #1 for chassis lubrication for normal temperatures.

(iii) General Purpose for wheel bearing lubrication for normal temperatures.

(iv) Heavy Duty Wheel Bearing grease #3 for wheel bearing lubrication in tropic areas..

(v) Grease #4 for Water Pump lubrication where necessary.

In addition to the above other greases were to be carried in Ordnance Workshops for special lubrication.

Cold Test trials conducted at Kapuskasing and Camp Shilo emphasized the limitation of the use of greases at low temperatures. Where chassis had to be lubricated at low temperatures the lubrication guns would not dispense #0 grease and subsequently it was recommended that gear oils be used in these conditions. There was some indication also that #2 grease did not provide satisfactory wheel bearing lubrication at low temperatures and it was recommended that grease be used under these conditions. This, not only to provide adequate lubrication but also to reduce the resistance to at these temperatures.

Various other special problems of lubrication were encountered, particularly at low temperatures in special components. For more detail on these problems the reports listed under "References" will be helpful.

REFERENCES

File 73-1-16.
Spec. O.A. Part III, Section XVIII.
Specification O.A. 216.
U.S.Army Specs. 2-106, 7, 8, 9 and 10.
D.N.D. Specs. 604, 670, 671, 672, 673.
Report on Kapuskasing Cold Tests.
Report on Camp Shilo Cold Tests.
Report on Exercise Eskimo.
Report E-599,Trico W/S Wiper Lubricant.
Report E-273, Wheel Bearing Greases, Normoyle, Texas.
Report E-110,Lubrication with Uni-Gun.

HYDRAULIC FLUIDS

Insofar as MT vehicles are concerned the important item under this category is that of Brake Fluids. Throughout the war motor vehicle manufacturers supplied their regular commercial fluids in their vehicles except in the case of special orders for Arctic areas.

In the early part of 1942 authorities in U. K. reported that difficulty was being experienced with Canadian vehicles due to the addition of W. D. Brake Fluids to the brake fluids shipped in vehicles from Canada. At that time the problem was referred to National Research Council for investigation. Mixtures of the various brake fluids were compounded but no detrimental results occurred. U.K. were advised of these findings and no further questions were raisedon this phase of the problem throughout the war.

Cold Test development work carried out in the motor vehicle manufacturers cold following the Kapuskasing Trials indicated that the standard commercial brake fluids were not entirely satisfactory at temperatures below minus 20°F. Various fluids were investigated and R.C.A.F. 311 was found to give the required characteristics and D.N.D. Specification 510 was written to cover this compound. Following this investigation orders for vehicles for low temperatures specified that the brakes must be serviced with a fluid having low temperature characteristics equivalent to D.N.D. 510. This fluid was adopted as the standard brake fluid for year round use by the Canadian Army. Some doubt was expressed as to whether it would be satisfactory at higher temperatures and to determine this supplies of it were installed in vehicles under Tire Tests at relatively high temperatures and service at Normoyle Texas. These tests proved it satisfactory for year round use.

Two other items were the subject of investigation in connection with MT vehicles -

(a) Fluid for mechanism of Hydraulic Dump Trucks.

Commercial practise had been to specify a mineral oil,more because of its cost than because of its overall

usefulness. When Dump Trucks were [redacted] red for Arctic [redacted] it [redacted] found that this commercial oil [redacted] unsuitable. Investigations in [redacted] Cold Room using brake fluids [redacted] various petroleum oils indicated that the seasonal engine oil [redacted] satisfactory.

(b) Two types of fluids [redacted] required for the two types of shock absorbers, the vane and the piston types.

Shock Absorber Manufacturers speci- [redacted] special mineral oils and the [redacted] and U.S. Armies carried oils in ordnance supply which corresponded fairly closely to the manufacturers' specifications.

However in [redacted] U.K. the British [redacted] Canadian authorities considered that [redacted] generally available materials could be [redacted]d in combat areas with reasonable satisfaction. For this rea- [redacted] they specified the use of brake fluid for piston type shock absorbers [redacted] seasonal engine oil for the vane type. In addition to the above General Motors recommended, as a result of Cold Room tests, that the standard piston type shock absorber fluids be diluted with Stoddarts solvent for vehicles specially built for operation in minus 40°F areas.

Other hydraulic problems [redacted] encountered [redacted] certain of the Armoured vehicles such [redacted] fluid for the hydraulic traversing mechanism and for the recoil system of the guns. These were investigated at Camp Shilo [redacted] subsequently in Cold Room development work carried out by [redacted] U. S. and Canadian Armies. The ideal was to have one fluid which would give satisfactory service for all temperature [redacted]es. This requirement was approached by oil - to Specification 3-GP-26.

REFERENCES

Specification O.A. 216.
D. N. D. Specification 510, U. S. Army 2-111 - Fluid, Hydraulic [redacted].
D. N. D. 38 Oil [redacted] (Piston Type Shocks).
D.N.D. 595 Fluid Shock Absorber Heavy (Vane Type Shocks).
[redacted] Specification 3-GP-26 Oil for Hydraulic Mechanisms.
N.R.C. Report CS86-418 Miscibility of Brake Fluids.
N.R.C. Report MO-167 Viscosity Tests on Brake Fluids.
Report E-147 [redacted] Fluids at Normoyle Texas.
Report [redacted] Camp Shilo Cold Tests.
Report E-358 Hydraulic Fluid for Dump Trucks.
Report on Eskimo Exercise.

PAINTING

Painting of Army Vehicles has deviated from commercial practice particularly in regard to the formula of the paint and the type of finish.

In the initial stages the specifications for paint were based on those developed by the British War Office. From time to time modifications have been made to the specifications to suit manufacturing conditions in Canada although the basic requirements laid down by the British War Office were retained. The basic requirements were -

1. That the finish be "matte" to decrease the degree of reflection from the sun or lights which reduced the tendency to reveal the vehicle's location.

2. That the finish must be gas decontaminable and gas resistant. This requirement was to prevent blistering of the paint of a vehicle which had been subjected to an enemy gas attack and also so that the surface could be cleansed from the gas itself otherwise it would be detrimental to personnel of the vehicle who might come in contact with it.

3. Certain restrictions were laid down as to the percentage of lead compounds particularly for the paint used for the interior of "closed type" Armoured Vehicles. This to reduce the hazards from lead poisoning when, due to impingement of explosives, particles might flake off and be absorbed by the occupants.

The paint applied by the Vehicle Manufacturer was considered the basic colour on top of which the Army would apply the camouflage disruptive colour. Originally all vehicles going to the European theatre of war were painted Khaki Green #3 and those going to the Middle East were painted Lightstone #61, both colours were in accordance with British Standards. Later Khaki Green #3 was changed to Brown #2, and still later, after the U.S. Forces had arrived in England in strength, to the U.S. Olive Drab.

Due to the pooling of vehicles, and the difficulty of determining in production their ultimate destination, it was decided later, to paint all vehicles the one colour in production and, where necessary, the Army would repaint with the colour required for any particular theatre of war.

At one stage the British Ministry of Supply requested that all vehicles going to the Middle East be camouflaged. However, it proved impracticable to carry this out in production as proper camouflaging required a continuity of design and a variation from vehicle to vehicle to prevent a "stereotyed" appearance. It was impossible for the manufacturer to produce a continuity of design in production where, in many instances, the chassis and units were not matched until arrival at destination. Specification O.A.64, and certain camouflage patterns as referred to thereon, were developed before the decision to delete camouflage was made.

Rigid inspection of the paint after arrival at the Motor Vehicle Manufacturers' Plants proved impracticable, and it was decided to have inspection carried out before the paint was shipped from the paint companies. Immediately after a batch of paint was manufactured it was "bonded" and held in bond while approval tests were conducted. If the tests proved satisfactory the paint was released by the Inspection Authorities for shipment.

Preparation of the surfaces to be painted and the procedure followed in applying the paint was no problem to the large Motor Vehicle Manufacturers who had adequate facilities, and had followed good practices in commercial production. However, due to the tremendous demand for bodies and trailers, a multitude of small body and trailer companies were given large orders which taxed their facilities. In these instances, few had adequate provision for preparing the surfaces for painting and the facilities and little experience in doing a proper job. Frequent revision of the specification was found necessary to "tighten up" on the painting requirements so that the Inspecting Officer could force these smaller manufacturers to improve their processing and thereby ensure a satisfactory paint job.

When shipment of vehicles in quantity to tropic areas began, the problem of corrosion became a much more important factor. Liaison with U. S. Ordnance, who had had a wide experience in the tropic areas, indicated that thorough cleaning before painting was the important factor in reducing corrosion to a minimum. This information was supplemented by a thorough investigation by the Paint Research Laboratory of National Research Council in which it was determined that, in addition to thorough cleaning before painting, the application of a primer containing a minimum quantity of zinc chromate was desirable. Subsequently the paint specifications were revised, where necessary, to specify the improved finish required for vehicle operation in tropic areas. In order to meet the requirements of these revised specifications it was necessary, in many instances, to add to the manufacturer's painting facilities. In certain cases capital assistance was given the manufacturer for the additional equipment required.

Very few complaints were received from the field on paint jobs carried out by the Motor Vehicle Manufacturers, but numerous complaints were received on the finish provided by body manufacturers, particularly over welded joints.

Specification O. A. was originally written to cover the preparation for painting, the painting procedure, the quality of the paint and the method of inspection. It was found that this overall specification was too cumbersome and did not identify individual products satisfactorily. For this reason Specification O. A. 76 was rewritten as a "Procedure" and "Control" specification with cross-references to specifications covering individual products. Subsequently, the following individual specifications were developed:

O.A. 141 - Priming Paint for Metal.

O.A. 142 - Paint for Intermediate and Finish Coats.

O.A. 143 - Sealers for Wood.

O.A. 144 - Priming Paint for Wood.

O.A. 145 - Heat Resistant Paint for Intermediate Finish Coats.

O.A. 146 - Thinners for Paints.

O.A. 147 - Heat Resistant Paints for Exterior, Intermediate and Finish Coats.

O.A. 264 - Priming Paint for Light Gauge Metal.

Specifications O. A. 145 and O. A. 147 were developed to cover paint for application to Armoured Vehicles where impingement of explosives might raise the temperature of the paint to the ignition point creating a fire hazard to the occupants of the vehicle.

Specification O. A. was developed for application to the light gauge metal of House type bodies where it was considered that corrosion would be more serious than with heavier gauge metal, and for this reason

better protection against corrosion desirable.

Details of the application of each individual specification listed above will be found in Specification C. A. 76.

Problems related to painting were investigated by the Paint Research Laboratory of the National Research Council and its representative, acting on our behalf, would in turn, discuss proposed changes with the Paint Advisory Technical Committee. This Committee included Industry representatives and representatives of the Inspection Board.

Changes in vehicle design or the introduction of new or substitute materials frequently required modifications to the Paint Procedure, or at least a certain amount of research to determine that the established procedure was satisfactory.

Items of this category were:

Substitution of aluminum for steel in certain bodies.

Substitution of American hardwoods for Canadian hardwoods.

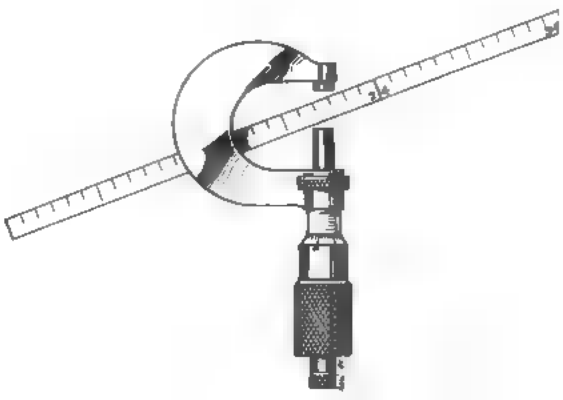
The use of thin plywood and masonite as interior sheeting of house type bodies.

The application of paint over cadmium plate, terne plate and galvanized iron.

REFERENCES:

File 73-1-21.
Specification C. A. 76.
Specifications C.A.141,2,3,4,5,6 and 7.
Specification C. A. 264.

TESTING
&
SERVICE ENGINEERING

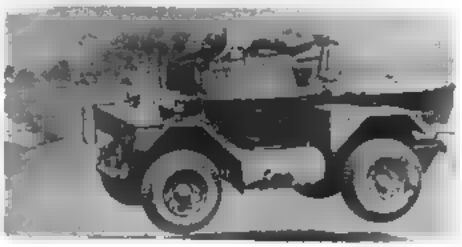


DEVELOPMENT TESTING

Testing is an integral part of vehicle design.

At the beginning of the war there were no proving grounds in Canada and indoor testing facilities were strictly limited.

There was a great difference of opinion regarding what a vehicle should be able to do. As the Canadian Army had not previously possessed more than a mere handful of vehicles designed for military purposes, it did not have any background to form a basis for assessing vehicle performance. The most common form of testing applied by the Army was that of riding the vehicle "hell for leather" [redacted] country. This had the effect of over-emphasizing certain features and neglecting others.



As time progressed testing was brought into more orderly procedure. Both Ford and General Motors selected tracts of land to be used for design proof testing during the development of design. The General Motors Proving Ground at Milford, [redacted]gan, was used for a number of performance tests. There was a need, however, for a common ground or yardstick within Canada by which these two makes, plus all others, could be assessed. Further, there were trials to be made in which the central design control and the military requirement groups could collaborate. For this purpose a test site was selected on the Montreal Road near Ottawa.

Development of this site continued from the time of purchase until the end of hostilities. The proving ground is the property of the Department of National Defence and was developed to its present state by that Department but, as agreed upon at the time of its origin, it was used also by D.M.& S. A report on the facilities of this proving ground is now under preparation by D.N.D. For interim reports by A.E.D.B. see "Testing Facilities & Methods used by Army Engineering Design Branch", E.P. Report No. E631 and Report No. 250.

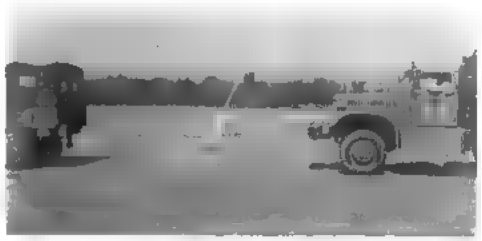
GRADIENT NUMBER	1	2	3	4	5	6
PER CENT OF GRADE	15	20	30	40	50	60
LENGTH OF GRADE (APPROX.)	184'	184'	150'	159'	145'	163'
SURFACE	WATER BOUND MACADAM		CORRUGATED CONCRETE			

TEST GRADIENTS
V P E OTTAWA

The first overseas shipments of vehicles were sent to the U.K. where they were delivered first to the Canadian Forces and later to British Forces. In order that these vehicles could be compared with their British counterparts, they were subjected to tests on British proving grounds. In the main the performance [redacted] rated [redacted] being satisfactory but certain tests were applied to which the pilot models had not been subjected in Canada due to lack of facilities or a lack of knowledge of requirement. As a result some features were found which were below the standard at which the British aimed. Fortunately none of the points, which were criticized as a result of test, were of [redacted] extremely vital nature; however, they did show the necessity of creating, in Canada, test-yardsticks which were common with those employed by the Canadian and British Users in the U.K.

It was not practical to incur the delay which would result from building a pilot and shipping it to England for test before commencing production. Neither was it wise to produce in volume and ship to England before any British-type testing had been done. The only solution was to test in Canada to British standards. This necessitated the construction of a number of special test courses and other facilities. Obviously it would have been wasteful to build these at each of two or more contractors' plants. The logical location was at the Government proving ground.

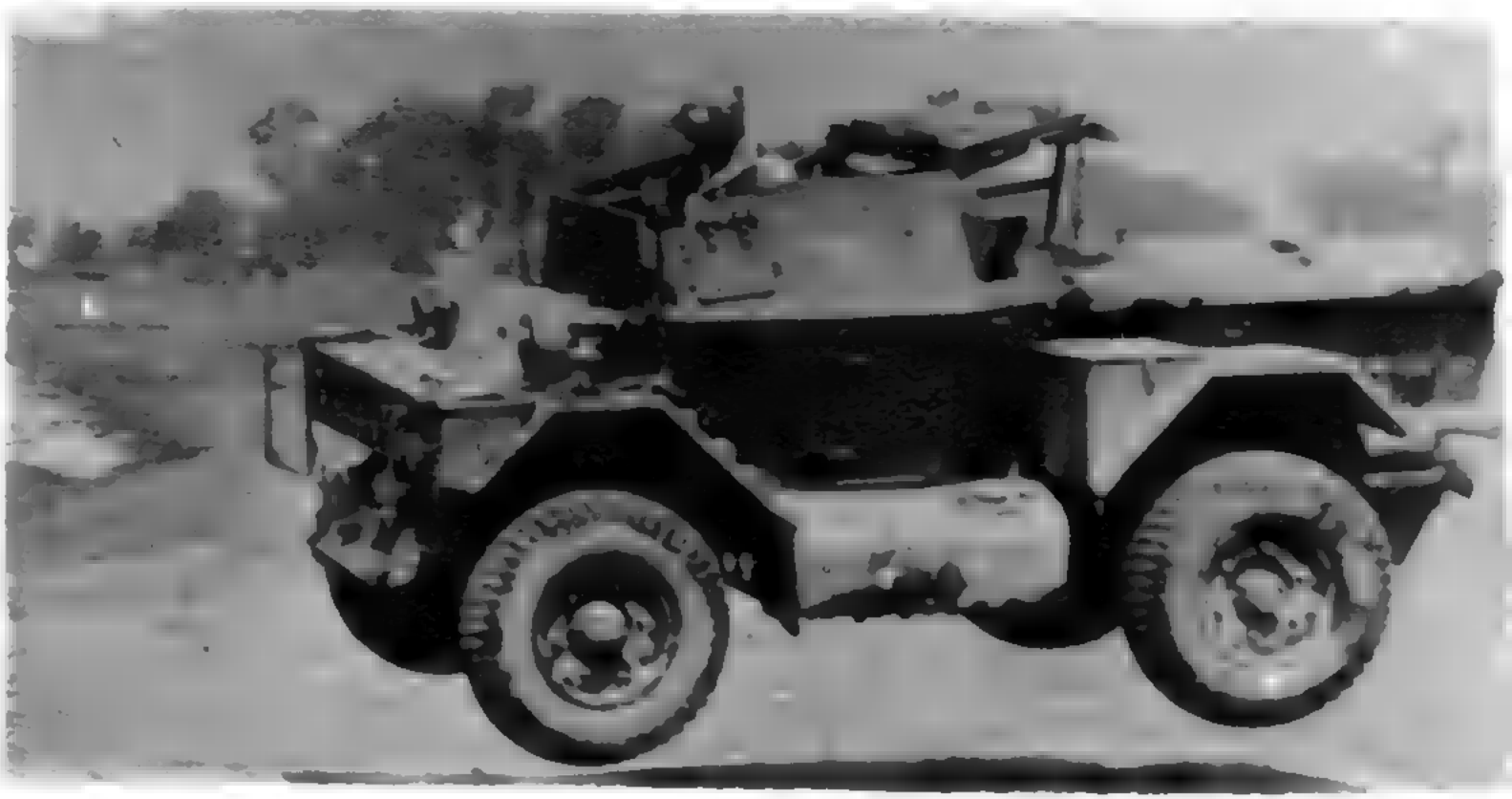
The design of U.S. proving grounds was purposely allowed to influence the D.N.D. development and quite rightly, but, as the Canadian-made vehicles were destined for use with British Commonwealth troops, the detail test facilities were developed to compare with those set up in the U.K.

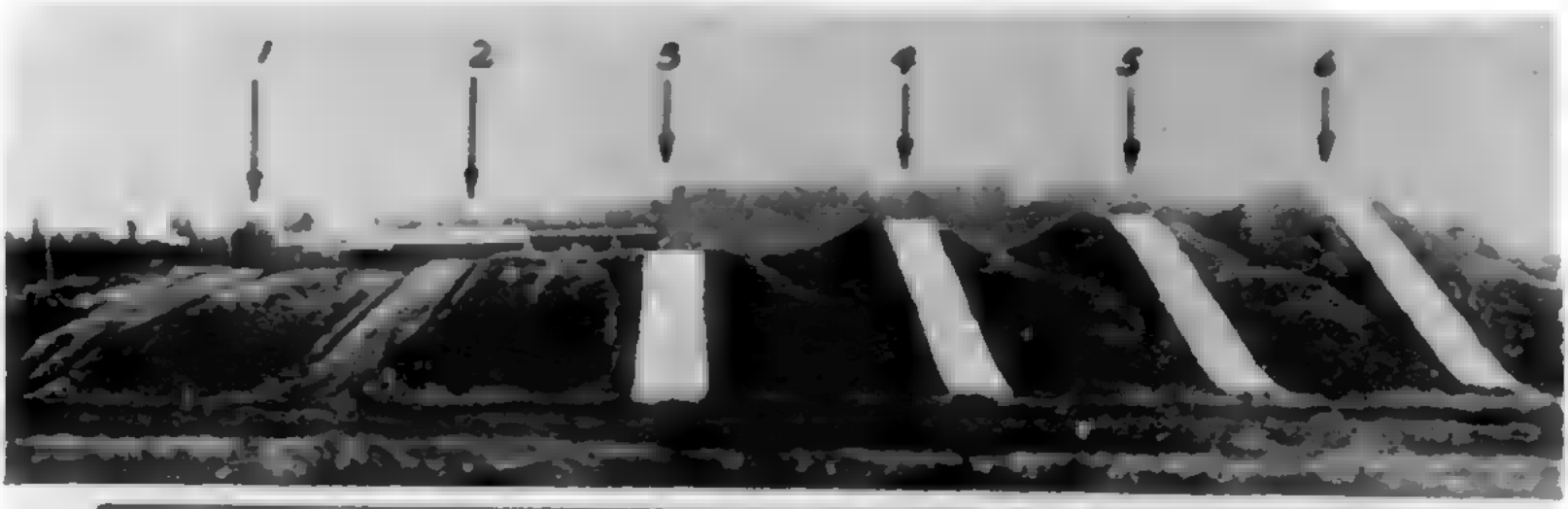


In addition to the provision of special facilities, the possession of the Proving Ground area permitted a large part of testing to take place off public highways. However, certain very good rough hill courses in the Gatineau district were used extensively.

A short history concerning the Government wartime testing organization is necessary here because it has value, as background, for the making of future plans.

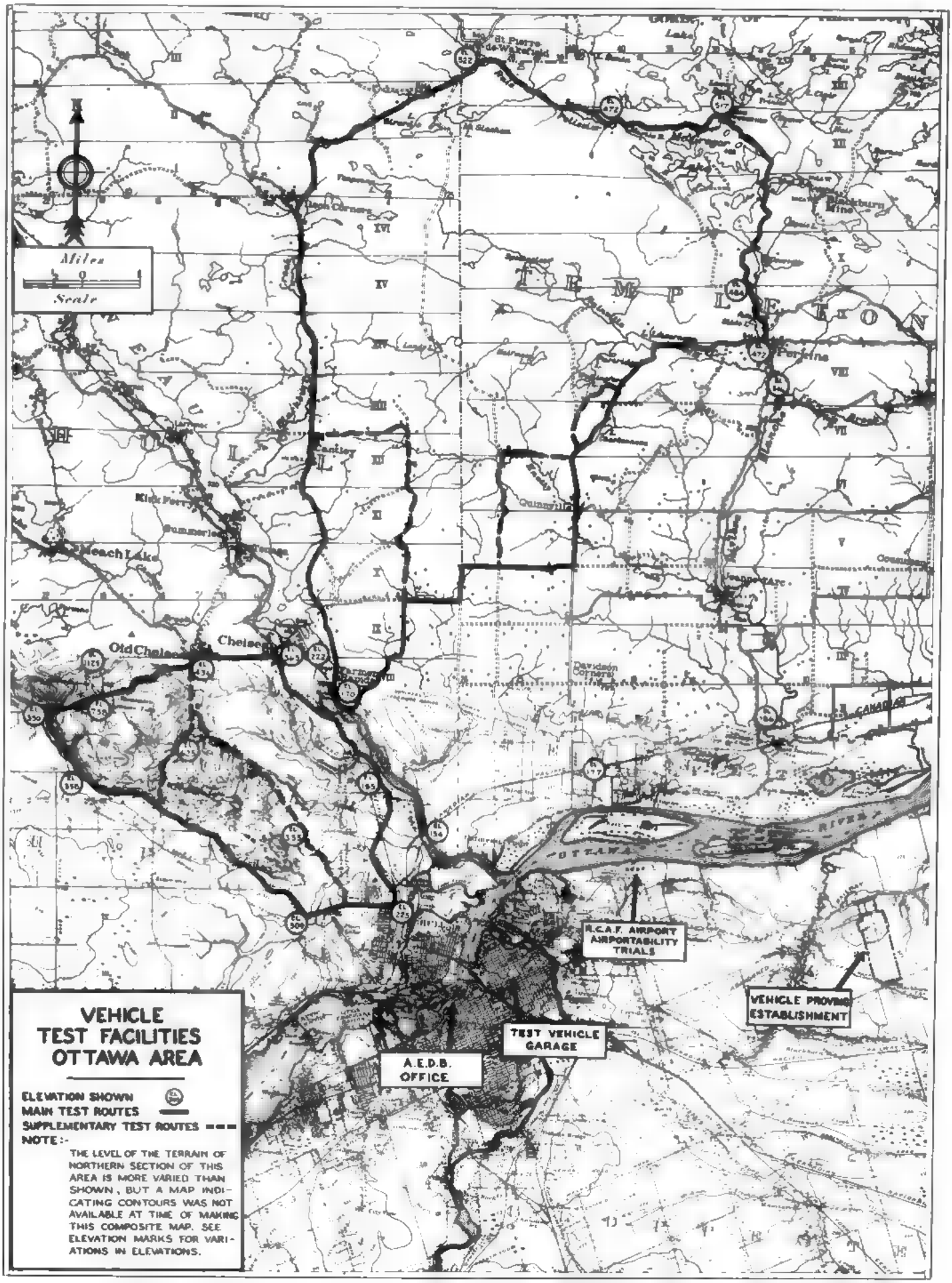
The Montreal Road site had been obtained by the Vehicle Design Group while the latter [redacted] still a part of D.N.D. When design was transferred to D.M.& S., the proving ground was retained by D.N.D. The latter Department has since developed it into a very elaborate plant.





GRADIENT NUMBER	1	2	3	4	5	6
PER CENT OF GRADE	15	20	30	40	50	60
LENGTH OF GRADE (APPROX.)	184'	184'	150'	159'	145'	153'
SURFACE	WATER BOUND MACADAM		CORRUGATED CONCRETE			

TEST GRADIENTS
V. P. E. OTTAWA

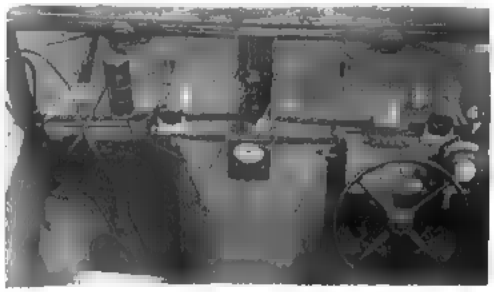

Miles
0
Scale
TEMPLETON
Perkins
Blackburn Mills
Kirk Ferry
Meach Lake
Old Chelsea
Chelsea
Davidson Corners
OTTAWA RIVER
R.C.A.F. AIRPORT AIRPORTABILITY TRIALS
VEHICLE PROVING ESTABLISHMENT
TEST VEHICLE GARAGE
A.E.D.B. OFFICE
VEHICLE TEST FACILITIES OTTAWA AREA
ELEVATION SHOWN
MAIN TEST ROUTES
SUPPLEMENTARY TEST ROUTES
NOTE:-
THE LEVEL OF THE TERRAIN OF NORTHERN SECTION OF THIS AREA IS MORE VARIED THAN SHOWN, BUT A MAP INDICATING CONTOURS WAS NOT AVAILABLE AT TIME OF MAKING THIS COMPOSITE MAP. SEE ELEVATION MARKS FOR VARIATIONS IN ELEVATIONS.

It was planned that D.N.D. would test for D.M.&S. under the latter's direction and that it would also make the necessary acceptance tests from a military standpoint. It turned out, however, that D.N.D. had difficulty in finding the required staff and, at the suggestion of the M.G.O., the Army Engineering Design Branch set up a Test Wing, based on civilians, which as to use the D.N.D. Proving-Ground facilities. In the main, this worked out fairly well, although there were several controversies between the two bodies.

The main point of difference was occasioned by a difference of opinion as to which body should do certain tests. Design contended that it should not have to submit a vehicle for test by the User until it was ready to do so, and on whatever tests it chose to run itself. Certain officials, in D.N.D., contended that the tests should all be handled by D.N.D. in spite of the arrangement mentioned in the immediately preceding paragraph.

This controversy was finally settled. It was agreed that development testing is an essential part of vehicle design and development; that ultimately the User may subject the vehicle to those tests which represent the service to which he proposes to subject it in the field, and which have been stated in his original requirement.

As finally arranged the testing is being done to the general satisfaction of the Designer and the User and common-sense co-operation is employed to avoid overlapping or omissions. The best proof that the test work performed in Canada was efficient after facilities became available, may be had by studying the reports of subsequent U.K. tests and noting the small number of criticisms.



In the early days, prior to the development of the properly controlled tests at the Proving Ground, the vehicle contractors had been disturbed at times by the tests applied by Army personnel. Although service usage in theatres of war justified much of this early Army testing, there were certain extremes which were subsequently shown to be more severe than necessary. These latter tended to throw design out of balance, by resulting in vehicles which were unduly heavy, thus stepping-up durability by sacrificing some other performance feature beyond a point which was essential. A great deal of time was spent by Government design personnel in an effort to determine the correct emphasis to be placed upon the test related to each feature of design so as to produce a properly balanced whole which would satisfactorily meet military needs. Studies of the methods employed in the U.K. and the U.S. were repeatedly made and very close comparisons were made of test reports vs. reports from Users in theatres of war.

It is believed that the tests which were applied at the D.N.D. Proving Ground in the last year or so were, in the main, agreed upon by the contractors as being practical simulations of field conditions.

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Several major tests of a special nature took place outside the Proving Ground area. The chief of these were:-

Cold Test Trials at Kapuskasing, Ontario - Report Feb. 1942,

Cold Test Trials at Camp Shilo, Manitoba - Some Section of Report By D.N.D., "Cold Weather Camp Shilo, Manitoba, 1942-43",

Synthetic Pneumatic Tire Tests at Normoyle, Texas - See Report E-552, May 1943 - June 1945,

Synthetic Bogie Tire Tests at Phoenix, Arizona - See Report - 1944,

Wadeproofing Tests at Comox, British Columbia - See Report - August 1945.

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The testing facilities of industry and of research organizations largely utilized will be noted in other parts of this Design Development Record. Ford equipment in Windsor and at Fort Rouge was used to great advantage. Chrysler Laboratories in Detroit provided valuable data. Considerable work was done in the cold rooms of the Olds Motor Works, Lansing. National Research Council and the Bureau of Mines were constantly handling A.E.D.B. projects.

A number of special test installations were made, in addition to those at the Proving Ground, chief of which were probably the Vehicle Cold Room and Chassis dynamometer at the plant of General Motors, Oshawa.

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A basic chassis may be used in a multiplicity of combinations of body, chassis payload and equipment. It soon became apparent to the design group that the details involving weights must be available at all times; but it was surprising how many interpretations of weight analysis may be made and how confusing may become the terms governing weights, - such as "payload", "curb-weight", "equipment", "personnel", etc. Even the method of weighing a vehicle can be varied.

Similar complications arose regarding dimensional measurements and nomenclature.

Because of these possibilities of confusion it was found, at times, that records were confusing and also that information on key items might be missing. Consequently a decision was made that no "Pilot Model Approval" would be formally issued until all such data had been recorded and for this purpose a series of forms were developed. These forms may look rather formidable but for the benefit of the future military design, it should be recorded that they very definitely did save time in the long run. A typical example of the use of this form may be seen by referring to E.E. Report No. E547.

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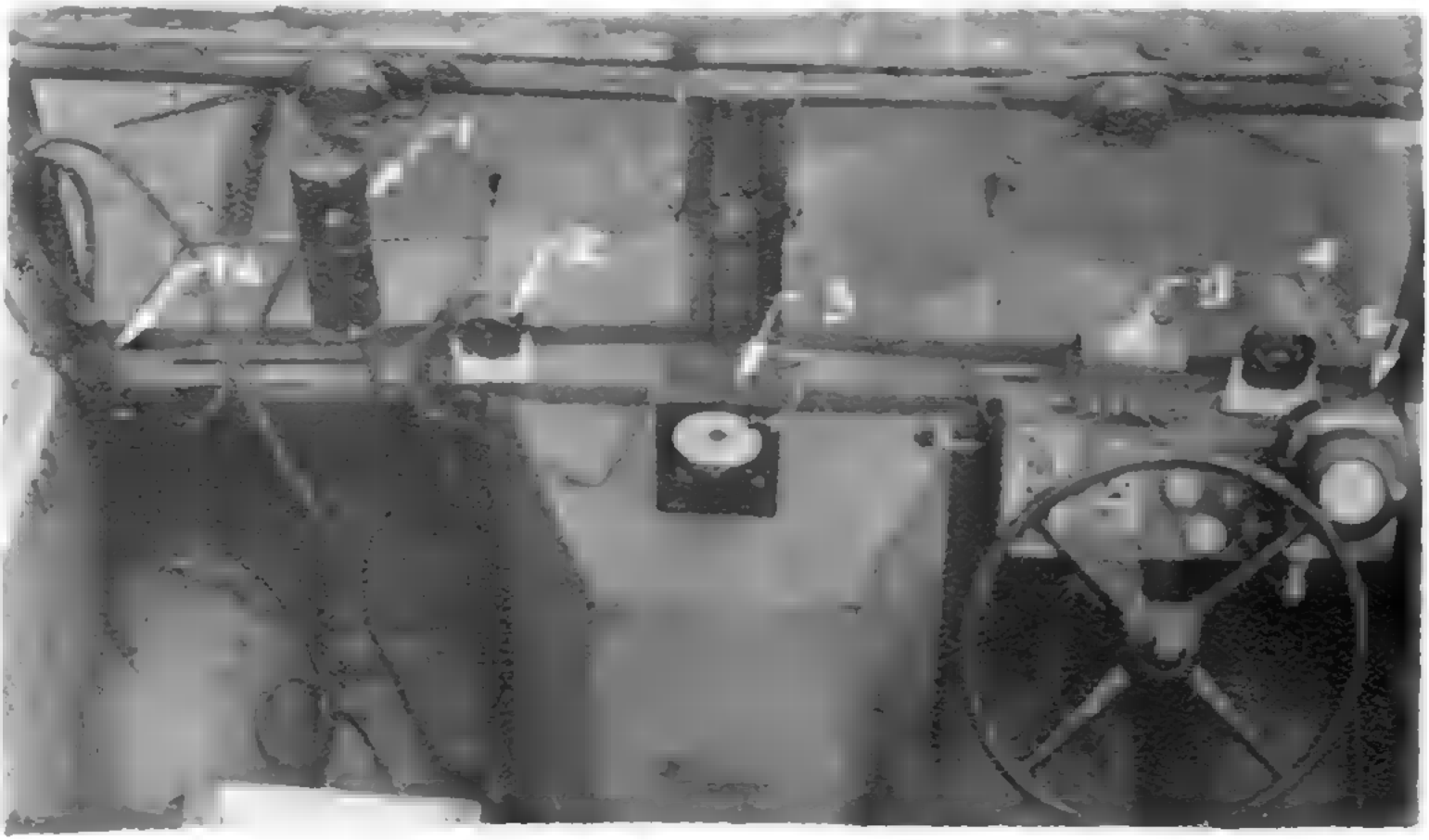
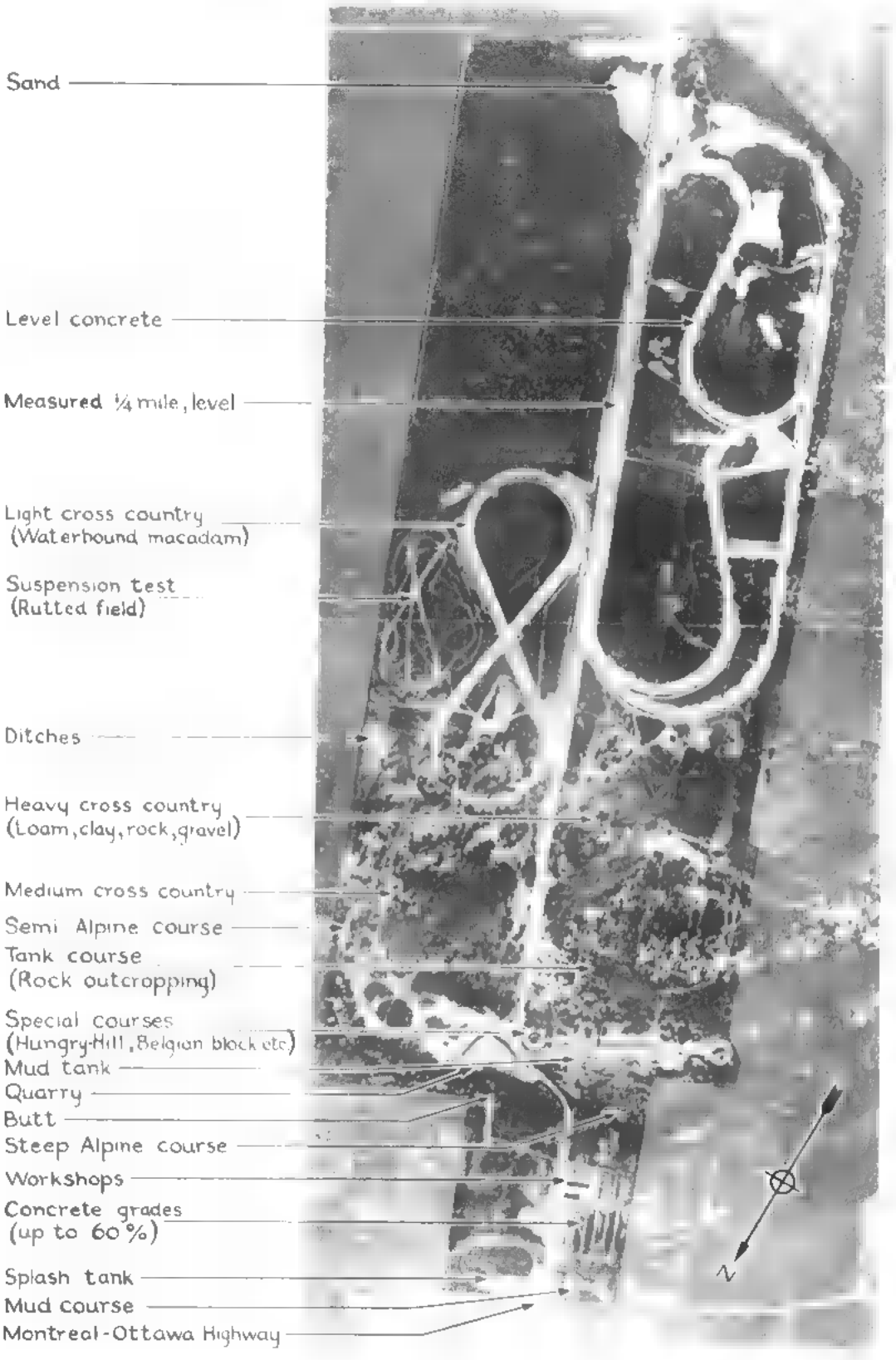
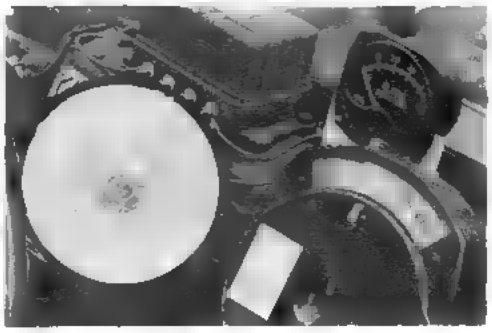
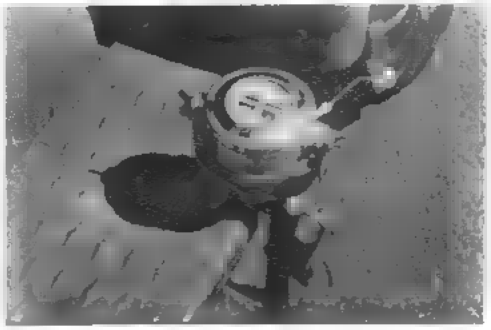
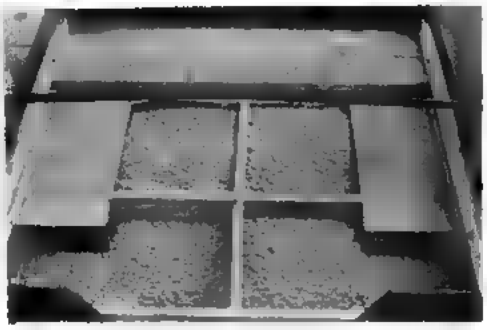
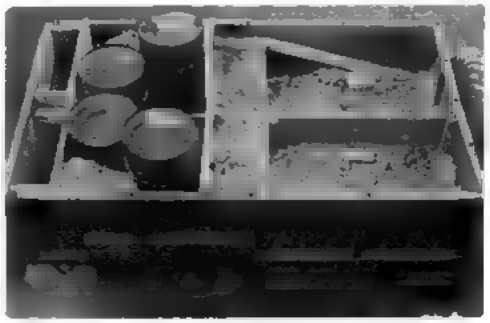
In performing tests it is essential that the results of one test may be compared with the results of another test. This means that standard yardsticks must be used and, further, that they must be used in similar ways. For this reason it is necessary to set up a complete and definite test procedure; at the same time permitting all necessary flexibility to suit any individual case. The forms for this purpose may be found in report "Sample Performance and Reliability Data Chart to be used by Experimental Engineering Section".



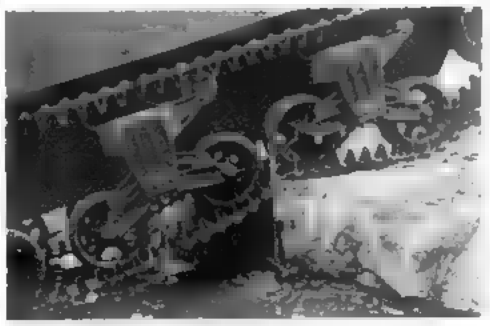
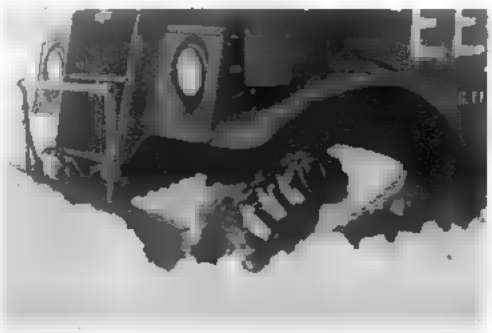


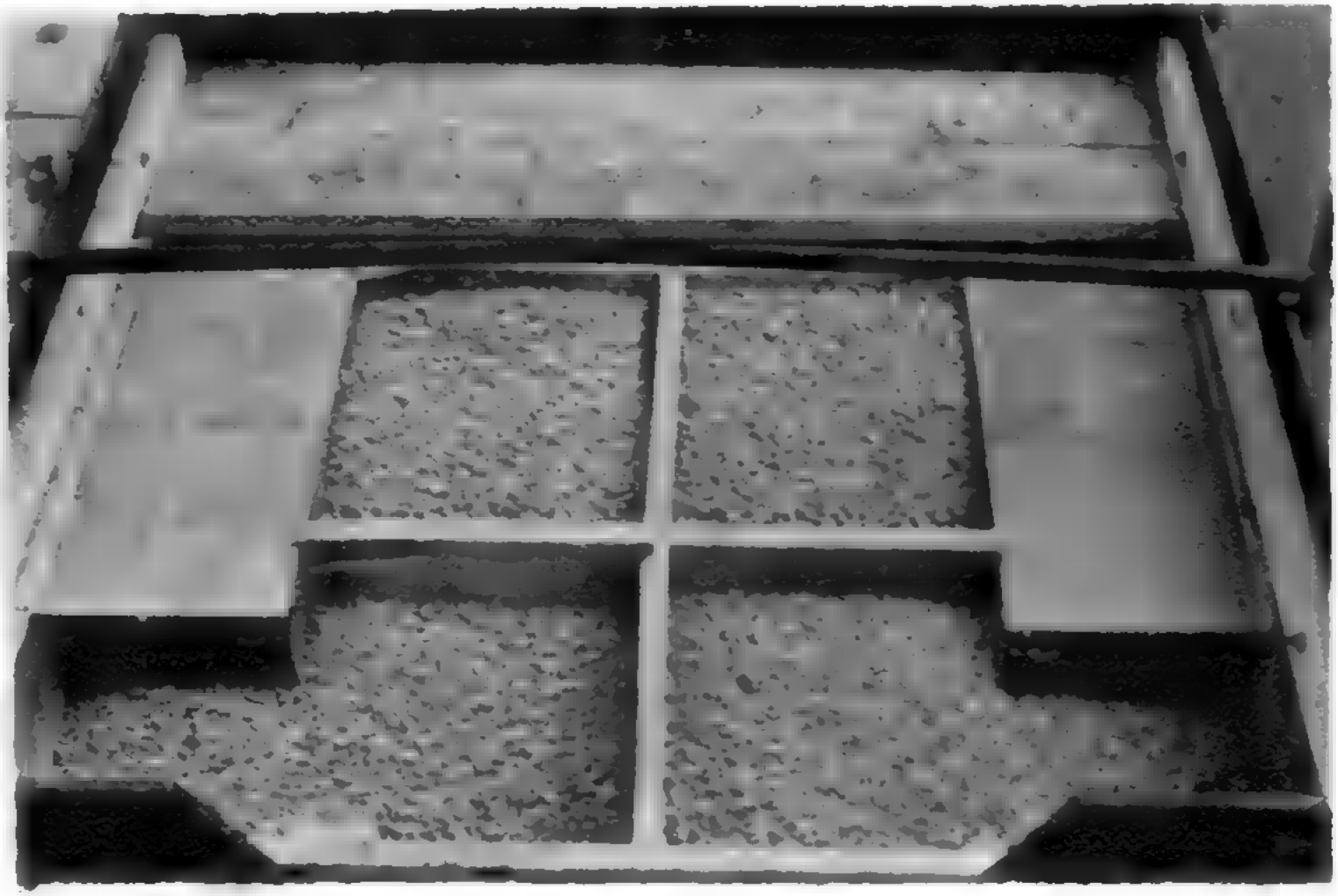
AERIAL VIEW
VEHICLE PROVING ESTABLISHMENT
OTTAWA

WIDTH APPROX. 900 YDS.
LENGTH APPROX. 2850 YDS.



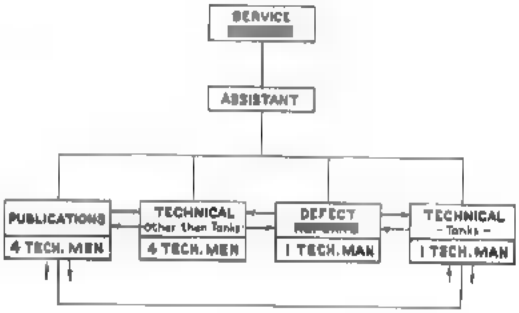



SERVICE ENGINEERING

In addition to its strictly design development phases, Army Engineering Design Branch was from inception charged with the correlated responsibility of seeing that Users were provided with the technical information necessary for the efficient operation and maintenance of vehicles and equipments produced to its specifications. It was likewise charged with the complementary responsibility of maintaining the closest possible touch with user field experience — that this would be reflected as rapidly and as accurately as possible in improved products.

Full responsibility for this phase of the branch's function — lodged with a centralized group of technically trained personnel drawn from industry and designated — "Service Engineering Section".



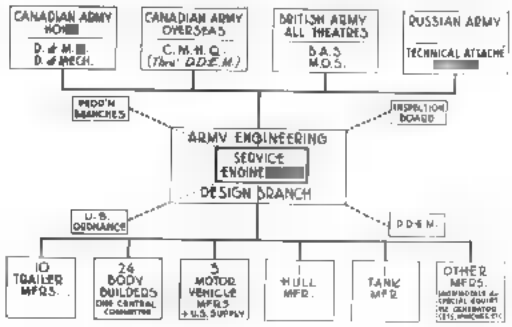
From a nucleus of three officers in 1941, Service Engineering Section reached a peak establishment of twelve technical men in the early part of 1944. The organization as it existed at that time is shown in the above chart.

-x--x--x--x--x--x--x--x--x-

Broadly speaking, the prime purpose of Service Engineering Section was that of providing an effective operational link between the User Services on the one hand and the Design, Manufacturing and Supplier groups on the other in respect of all matters pertaining to the operation and maintenance of vehicles and equipments in the field. The fulfilment of this purpose entailed the major functions described below.

(1) LIAISON

This function is illustrated graphically in the chart below.



The basic function of liaison constituted the foundation upon which all other functions rested and was comprised, essentially, of the following phases:-

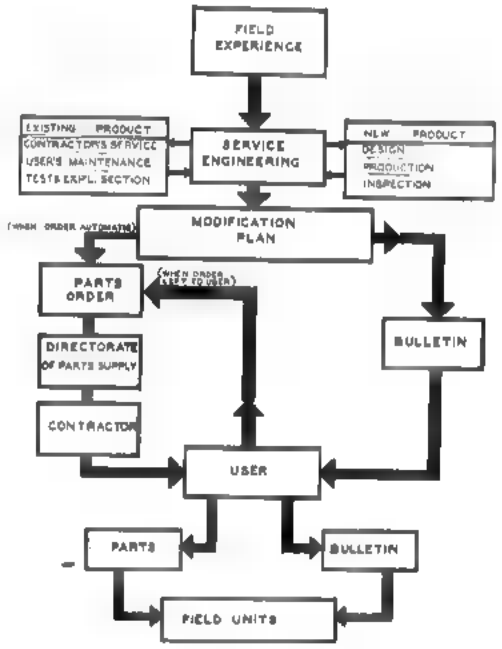
(i) Establishing and maintaining a satisfactory relationship between User requirements and Supplier performance.

(ii) Achieving as great a degree of standardization as possible between individual User preferences in the matter of operational and maintenance literature.

(iii) Representing the User viewpoint with Design and Manufacturing groups, and vice versa.

(iv) Acting as a general source of reference for Users' Maintenance organizations.

(2) FIELD MODIFICATIONS



Under this heading is included one of the most important functions of Service Engineering Section. Broadly, it involved making available to users the modification kits and installation instructions required to bring issued vehicles up to the standard of later improved design. This function is graphically illustrated in the chart above.

Where a modification was considered to be vital to the efficient performance of existing equipment the function included so-called "automatic provision" of material under a procedure especially developed for the purpose. (For detail of this procedure see page 37). In all other instances, the availability of kits was made known through the medium of Service Bulletins and users requisitioned the material through regular procurement channels.

(3) - **SERVICE PUBLICATIONS**

Centralized control and handling of operational and maintenance publications represented a good part of the total Service Engineering job. These comprised the following:-

A - Vehicle and Equipment Books

(i) Driver's Handbooks and Maintenance Manuals;-the basic vehicle chassis and cab publications.

(ii) Trailer, Body and Equipment Manuals.

B - Technical Bulletins and Letters

(i) Vehicle manufacturers' Service Information Bulletins;-supplementary to vehicle books prepared by manufacturers.

(ii) D.M.&S. Field Application Letters;-the medium for transmitting to Users' H.Q. groups the recommended application of items dealt with in manufacturers' bulletins.

(iii) D.M.&S. Service Information Letters (one General and One Tank series);-supplementary to vehicle and equipment manuals prepared by A.E.D.B., also to instruct on approved field modifications.

Representative examples of the various types of Service Publications are illustrated and identified below, but no attempt has been made to show all of the many kinds of manuals.- A complete set of all manuals, bulletins and technical letters issued has been placed in permanent records.

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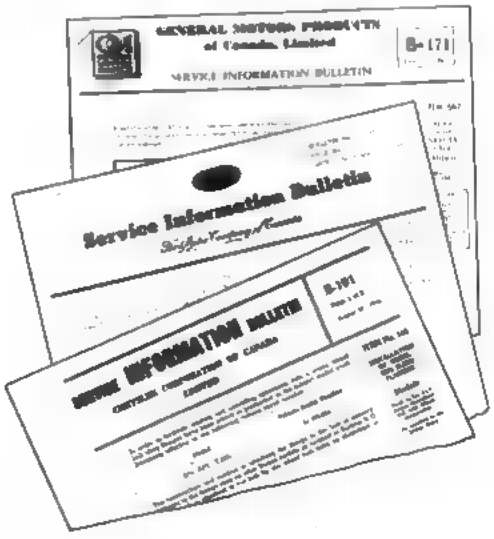
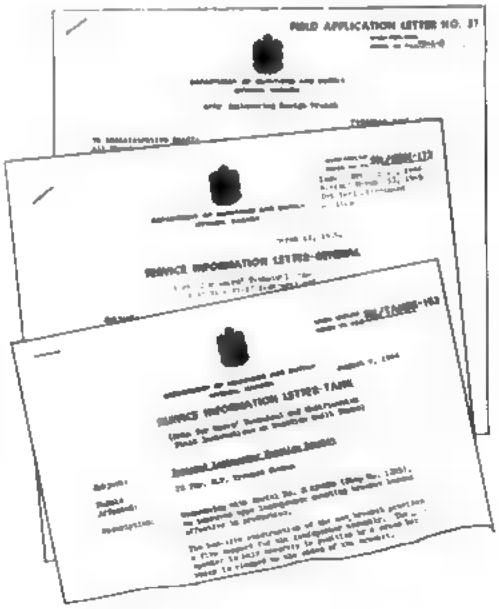
Vehicle Manufacturers' Books

Manufacturer's Equipment Manual
and
D.M.&S. Body and Equipment Manual



Manufacturers' Bulletins

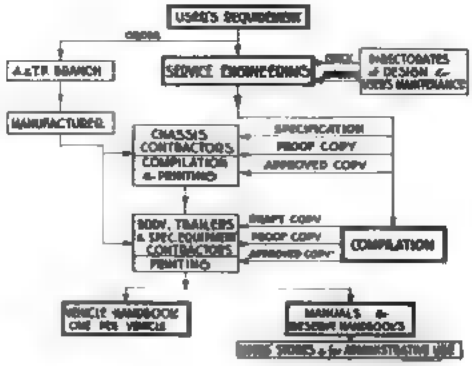


D.M.&S. Technical Letters

In the [illegible] of the Motor Vehicle Manufacturers, who had their [illegible] facilities for the preparation of suitable publications, the Branch function [illegible] largely one of general control, supervision and editorial work. In the case of practically all other vehicles, bodies, technical cargo equipment, etc., it involved the complete job from compilation to arranging for the printing.

Although in the earlier stages, U. S. Manuals [illegible] produced to Canadian pattern or to [illegible] suitably modified commercial one, they [illegible] later supplied to U.S. Ordnance specification.

The publications function in respect of Service Manuals is graphically illustrated in the accompanying chart.



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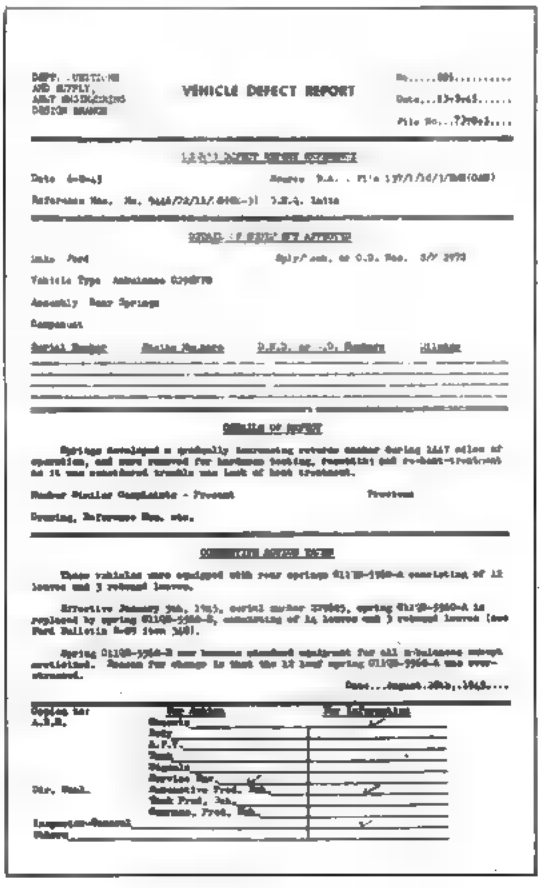
(4) - [illegible]

As a natural and necessary part of its function in representing the reactions and requirements of User Maintenance groups, Service Engineering Section was from its inception charged with the responsibility of dealing with defect reports on behalf of the Branch proper. It [illegible] later constituted the central handling point for all vehicle and vehicle equipment reports from all sources. In this wider role, Service Engineering Section represented Manufacturing and Inspection Branches [illegible] well as A.E.D. Branch. (See Automotive Production Branch and Army Engineering Design Branch Standard Procedure No. 34, issued 11 June, 1942).



VEHICLE DEFECT REPORT

Date 6-8-43

Vehicle Type Ambulance G749TW

Assembly Rear Springs

Component

Serial Number | Number Produced | D.E.D. or O.O. Numbers | Mileage

Spring developed a gradually increasing reverse camber during 1547 miles of operation, and were removed for hardness testing, reassembly and re-heat-treatment as it was considered trouble was lack of heat treatment.

Number Similar Complaints - Present | Previous

Drawing, Reference Nos. etc.

These vehicles were equipped with rear springs G1139-1950-A consisting of 12 leaves and 3 rebound leaves.

Effective January 5th, 1943, serial number 279665, spring G1139-1950-A is replaced by spring G1139-1950-B, consisting of 14 leaves and 3 rebound leaves (see Ford Bulletin 8-09 item 3681).

Spring G1139-1950-B now becomes standard equipment for all 6-balance except ambulance. Reason for change is that the 12 leaf spring G1139-1950-A was overstressed.

Date...August.20th,.1943....

Copies to: A.E.D. | Key Action | Key Information

Dir. Mech. | Chassis | Body | A.F.V. | Tank | Engine | Service Mgr. | Automotive Prod. Mgr. | Tank Prod. Mgr. | Chassis. Prod. Mgr.

Inspector-General | Others

Originally, Service Engineering Section's responsibility in the foregoing regard [illegible] largely one of centralized handling, i.e. seeing that each report [illegible] directed to the proper authority for action, transmitting the answer back to the User and maintaining a record of defects. As time went by, this Section was called upon to assume more and more the responsibility of direct analysis and investigation with Contractors, Design Sections, etc. All interested groups were, however, kept fully informed in respect of both field reports and the [illegible] to them.

The form used by A. E. D. Branch in the centralized handling of defect reports is shown in the accompanying illustration. This is a reproduction of V. D. R. No. 885 [illegible] it went to Users' H. Q. Groups for information and whatever action was considered to be necessary. Check marks in the lower portion of the form indicate additional distribution to interested Design, Production and Inspection groups.

The latest procedure followed in the handling of incoming defect reports was, briefly, [illegible] follows:

(i) Upon receipt, each report [illegible] checked against existing records for duplication and entered in the records.

(ii) The data from each new report (or modification of a previous one) [illegible] transcribed onto a numbered D.M. & S. Vehicle Defect Report form and directed to the proper source for investigation and report, copies being passed to other interested Design, Production and Inspection groups for information.

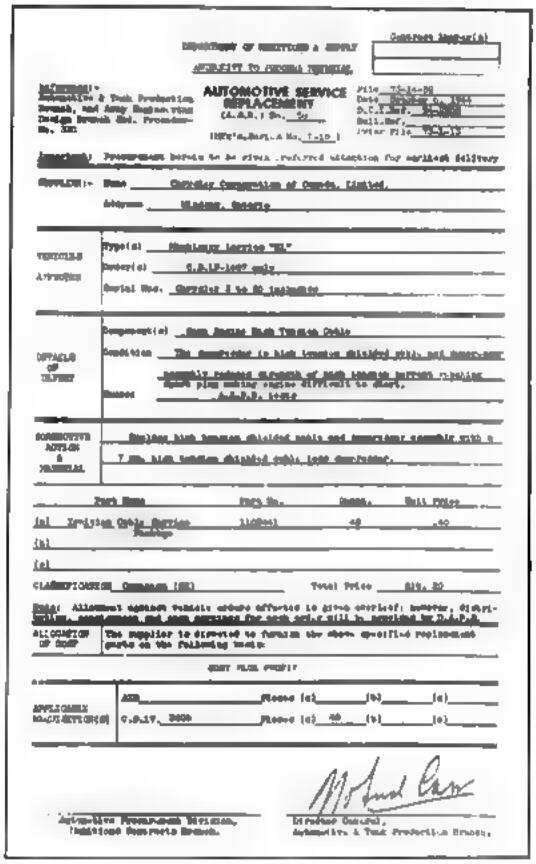
(iii) The subject [illegible] then placed on follow-up until the investigation had been [illegible] pleted. At this time the information was entered on sufficient copies of the V. D. R. to permit distribution to all Users and also to all interested Design, Production and Inspection groups.

In this type of activity it is obvious that no set rules can be rigidly adhered to, and none were. Each report was analized and treated [illegible] its merits and in accordance with organizational considerations. In some instances the Design group involved [illegible] requested to initiate and follow the investigation; in others Inspection, or Production [illegible] designated. The only inflexible rule was that Service Engineering assumed the responsibility for obtaining an answer to each report for transmission to Users.

SERVICE REPLACEMENTS

As mentioned under the previous heading of "Field Modifications", a special instrument was used to procure material of improved design for application in the field when it was considered important that prior-built equipment be brought up to latest standards.

Service Replacements procedure was originally developed to provide a means whereby the provision of replacement material under warranty could be demanded of the Motor Car Manufacturers in accordance with master contracts, and on an equitable basis consistent with the facts of each case. The



AUTOMOTIVE SERVICE REPLACEMENT

original procedure (Automotive Production Branch and Army Engineering Design Branch Standard Procedure No.33, effective March 7th 1942) was, in fact, issued under the subject title of "Warranty Replacements". Subsequently, however, the procedure was applied to the procurement of all field modification material. This broader application is covered in Standard Procedure No. 33C dated April 30th. 1945 for all vehicles except Tanks and S.P. Mounts on Tank Chassis. The latter was covered in Standard Procedure No. 57, dated May 31st. 1945.

In the early stages of use, when only warranty items were being dealt and User experience with Canadian built vehicles was not extensive, the decision to procure and ship field replacement material rested largely with Design and Production Branches of D.N.S., as determined from manufacturer's and local test experience. However, as experience increased and related liaison organization was improved the decisions became more and more those of Users' own representatives, but based on facts and recommendations provided by Design and Manufacturing Branches. This was always done by direct contact where feasible.

In effect, the Service Replacements system was one which permitted modification material to be procured and shipped to any destination without the need for any procurement demands by the consumers. This was found most beneficial, more particularly in the earlier stages of the war, in order to avoid damaging delays in the provision of urgently needed change-over material.

In any system of this kind, the financial arrangements are, obviously, of major importance. Although, theoretically, Service Engineering Section's responsibility ended with the development of the Specification for change-over Kit, in practice it automatically became involved in both the financial authority for procurement and in the general handling procedures.

So long as the master contracts were on a "cost plus" basis, the financial procedure was simple and straightforward. In effect, it was merely a matter of authorizing the manufacturer to supply material in addition to that required for vehicle production and to charge it against current vehicle orders (see Standard Procedures No. 33 and 33A). However, with the introduction of "fixed price" contracts in April of 1943, this simple arrangement was no longer feasible and it became necessary to set up special "blanket" accounts against which the expense of producing and handling of replacement materials could be charged (see later Standard Procedures Nos. 33B and 33C).- This later procedure necessitated the issue of covering Acceptances of Tender.

The form illustrated opposite is a reproduction of A.S.R. No. 59 as authorized by the Director General of Automotive & Tank Production Branch for supply by the manufacturer; it thus illustrates the detail of compilation.- The complete procedure of handling was, briefly, as follows:

(i) Upon definite indication that special replacement material would likely be needed, steps were taken to clarify the situation and to develop the detail of the kit required.

(ii) Representation was then made to the User and Users concerned and their concurrence in the provision established.

Note: In some instances, of course, the User initiated the requirement. In most cases, however, provision of replacement material followed the release (by D.C.I.) of corrective and improved design for production.

(iii) Upon agreement with Users as to provision, Service Engineering Section registered the tentative requirement with the supplier and prepared an A.S.R. to cover, except for pricing and allocation of expense.

(iv) The A.S.R. was routed to Automotive and Tank Production Branch for pricing, allocation of cost, signature, distribution and follow-up on provision.

As stated was the form proper, A.S.R. procurement called for preferred handling.

ELD CONTACT

There [redacted] very little direct contact [redacted]twe[redacted] Service Engineering Section of Army [redacted]gineering Design Branch and the ultimate [redacted]ers. With the exception of occasional con-[redacted]acts with Army Camps and Depots in Canada, [redacted]spondence for information on actual field [redacted]nditions and reactions rested almost en-[redacted]rely upon Users' Representatives in Canada [redacted]ainly R.E.M.E. and R.C.E.M.E.), D.D.E.M. and M.C.S. in the U.K., and Manufacturers' Representatives in the various theatres. Rare visits by A.E.D. Branch personnel to operational theatres produced additional valuable information.- The illustrations on this and the following page are typical photographic records of conditions viewed at first hand on such a visit by the Director General and Assistant Director General to North Western Europe in the dying stages of that campaign.

[redacted]

VEHICLE BACK LOADING POINT, THE NETHERLANDS

This general view of the Back Loading Point gives some idea of the wide variety of conditions available in one spot for analytical study.

All disabled vehicles in the area, from whatever cause, passed through this point for determination of subsequent action. A near-by R.E.M.E. mobile workshop performed the repairs on those vehicles which were not to be completely written off.

HEAVY UTILITY TRUCK

This H. U. Personnel Carrier selected here for study has met hard times, more particularly in respect of the front end. It is nevertheless capable of additional useful life after suitable repairs have been made. The general sturdiness of the body was obvious.

The notes which accompanied the photo drew particular attention to the following:

(i) Luggage rack (added)
(ii) Condensation tank
(iii) Jeep side lamps

STEEL BODY, 12 FT., G.S.

The subject of study in this instance was a standard type steel body which had absorbed a heavy collision impact. The localized damage was, of course, severe but the construction once again demonstrated its basic ruggedness.

The caption which accompanied this photograph as received said:

"We still maintain the body outlasts the chassis".

ARMOURED TRUCK 15 CWT. G.M.

This armoured personnel carrier had received a direct hit on the port bow without any more serious injury to its driver and mate than shock.

The condition of the left front fender gave clear indication of the more serious damage which would have resulted without the armour. The driver and mate would almost certainly have been killed.

The particular field contact during which the conditions depicted in the foregoing illustrations were viewed included visits to two Back Loading Points, [redacted] at Enschede containing 4000 Vehicles and one at Arnhem containing 3000. This offered what was perhaps a unique opportunity to make a [redacted] study of bodies, chassis and Vehicle components generally after actual battle experience. All common Vehicle types were represented and all conceivable varieties of casualty.

As a matter of interest and record, it was stated that over fifty percent of all vehicle casualties resulted from accidents, chiefly collision. The use of right hand drive [redacted] blamed by responsible Canadian Army personnel for this high incidence of accident casualties, which compared with some twenty percent caused by enemy action.

The very great amount of valuable information gained from the few direct field contacts undertaken by A.E.D.B. personnel made it more than obvious that regularly scheduled field contacts would have been of inestimable value to the Branch in fulfilling both its Design and Service Engineering functions.

NOTES IN RETROSPECT

As the heading implies, hereunder [redacted] registered retrospective notes, comments and appraisals covering a variety of subjects both directly and indirectly connected with the functions of Service Engineering Section. Recommendations for guidance in the establishment and operation of any equivalent future organization are included, but only by inference from actual experience.

EARLY PLANNING

In [redacted] early bustle of re-organizing Canadian motor vehicle manufacturers into a great supply house of military type vehicles, the less obvious but equally important requirement of maintenance in all its phases [redacted] subordinated to the [redacted] pressing matters of procurement. Some of the requirements which became fully apparent only after delivery of the vehicles to the ultimate Users were thus neglected in the basic structure and it was necessary to catch up later wher[redacted] possible, or to compromise where this was not completely feasible.

When in the late Fall of 1940 a Service Engineering Section was being organized, even those well versed in the requirements failed to visualise [redacted] full scope of such [redacted] activity in the somewhat new field of military organization. Also, as too frequently occurs, the original personnel became so involved in the matter of immediate requirements th a t early overall planning suffered as a consequence.

Some of the points referred to in the two foregoing paragraphs are discussed briefly under their individual headings below, along with other subjects which have been considered to deserve special comment in retrospect.

X X X X X

AFFILIATION AND STATUS

When Design [redacted] being transferred from Dept. of National Defence to Dept. of Munitions & Supply in June of 1941, there was some question as to whether the Service Engineering group should remain with Design or be attached to Production. It was finally agreed that the Service Engineering function [redacted] a proper adjunct of Design as a complementary and necessary technical service to User Maintenance Groups generally.

Also, from time to time during the ensuing years there was some tendency [redacted] the part of Dept. of National Defence personnel to question the status of Service Engineering Section in relation to Dept. of National Defence Maintenance groups. In February of 1944 a joint statement by responsible officials was made in respect of Vehicle Sections, Directorate of Mechanical Maintenance, D.N.D. and Service Engineering Section, Army Engineering Design Branch, D.M.&S. as a part of a [redacted] extensive inquiry into the relationship of functions and organization of the two Branches involved. - Following [redacted] outline of the respective functions of the two Sections, the following statements appeared:

" As will be [redacted] from the above outline of functions, there is a clear-cut division of responsibilities. There is no occasion for any duplication or overlapping of functions, nor does any exist.

There is obviously a need for very close collaboration between the two groups which, upon occasions, requires that personnel from each group be engaged upon the [redacted] project. This is, however, a matter of pooled effort which rightly exists between any inter-related groups.

As a matter of later record on this subject [redacted] related to post-war function, attention is also drawn to minutes of a meeting held September 20th, 1945 at A.E.D. Branch, D.M.&S. with D.N.E. representatives, M.G.O. Branch for the purpose of discussing the relationship of D.N.E., Vehicle Design Group and Industry in regard to field service, complaints and defects of Army vehicles in Canada.

X X X X X

[redacted] CONTACTS

In as much as liaison, with and on behalf of Users, constituted the heart of Service Engineering Section's operation, User contact [redacted] of its most important single functions. It [redacted] also its most varied one and, in many respects, the most difficult.- Brief notes on the contacts with different Users [redacted] given below:

Canadian Army

With minor exceptions there were two separate and distinct contacts with the Canadian Army. All dealings with Home Forces [redacted] through Vehicle Sections of D.M.E. (earlier D. of M.M. and C.O.M.E.) at N.D.H.Q. Practically all dealings with the Canadian Army Overseas [redacted] through D.D.E.M. (earlier T.A.(M)) at C.M.H.Q. This dual handling developed out of the fact that the first objective was to get Canadian equipment into the hands of the C.A.O. Relatively early development of an "on the spot" system for the control of standards of maintenance and modifications was a natural sequel and, except for certain internal ramifications, this control continued throughout the war.

The above described handling of the two branches of the Canadian Army as practical individual Users worked quite satisfactorily most of the time. There were, however, sufficient occasions when advantage would have accrued from decisions on behalf of C.A.O. being available from N.D.H.Q. to make this appear distinctly advantageous, provided it were feasible from the standpoint of military organization.

British Army

The first direct contact with a British representative [redacted] with the Technical Advisor to the British Purchasing Mission, a Ministry of Supply (TT2) official. This contact continued throughout the [redacted] supplementary to the basic design and provision liaison.

When in October of 1942 the R.E.M.E. Corps was formed as a separate Branch within the existing British Army Staff organization in Washington, a query arose [redacted] to the respective authority of the Ministry of Supply and the War Office in the matter of decisions on proposed field modifications. B.A.S. (R.E.M.E.) claimed full responsibility but, upon [redacted] to the highest U.K. authorities, Ministry of Supply was upheld in the case of "B" vehicles at least.

Since all other matters related to Vehicle Maintenance in the field [redacted] under the jurisdiction of British Army Staff and contact with R.E.M.E. personnel in Ottawa [redacted]

continuous, the handling of modifications through a separate and generally less accessible channel did not prove sufficiently practical. As the result of this, the following operational agreement was reached at a meeting held at D.M.&S., November 27th 1943.

> " It was agreed that D.M.&S. would make reference in all cases to D.A.D.M.E., B.A.S., Ottawa, who will be responsible for obtaining a decision in respect of all theatres, including the U.K. Where there exists any doubt as to U.K. requirements an agreed cable (Ascow series) is to be despatched. "

Officially, this left the T.T.2 North American representative as the supreme authority but, by his concurrence in the agreement, it permitted action on the basis that B.A.S. and A.E.D.B., when in conference, were acting on his behalf.

Clear-cut and generally recognized authority of a qualified representative located in Ottawa would have saved a tremendous amount of uncertainty, confusion and delay. (See memorandum dated April 13th 1944, File 73-14 on "Procedure on Modifications to Canadian Vehicles"; also cable VATEL 4873 dated 24-10-43).

Empire Countries

Considering the large quantities of Canadian vehicles which went to India and Australia particularly, there was far too little contact with these Users on matters concerning Service Engineering functions. Such infrequent contacts as did take place with technical personnel of the respective Supply Missions merely tended to emphasize the need for closer liaison.- There was no direct contact with representatives of any other Empire country.

After they became fully organized on this continent, R.E.M.E. Corps of British Army Staff acted to a considerable degree on behalf of other Empire Countries, more particularly India and Australia, in respect of defect reports. There was, therefore, a degree of continuous contact by proxy; also serious defects were generally registered direct through the respective Missions.

Other Allied Countries

In the later years of the War, effective direct contact on Service literature, defects, field modifications, etc., was established with the office of the Commercial Attache of the Russian Legation in Ottawa. Previously, liaison was established through War Supplies Limited, Washington in regard only to Service literature for vehicles going to Russia.

There was only a minor amount of direct contact with the Chinese Supply Mission in Ottawa.

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FIELD MODIFICATIONS

There is little question but that, in general, the provision of change-over material for field application was overdone. This was largely a matter of "playing safe" in the absence (more particularly, of course, in the earlier days) of an accurate requirement picture from the scene(s) of action.- At the same time, it is equally positive that, in certain instances, needed modification material was not made available as promptly as was required. The balance is rather fine, the perfect system being capable of the fastest action, but carefully controlled at the initiation end to prevent over-application.

Although the A.S.R. and T.S.R. systems, discussed previously, were designed as a means of prompt procurement of modification material, they were not as effective in practice as is required. Normal procedure called for vehicle production and related spares to take precedance over modification material, and this was not easily altered to meet emergencies. Also, the apparent lack of adequate status with the Motor Car Companies was a source of delay upon occasions.

In retrospect it would appear essential that facilities for emergent provision of modification material be made an integral part of basic contracts and that authority to supply be established on the same basis as authority for design changes (D.C.I.'s or equivalent).- As a matter of interest in this general regard, reference is made to the article "Field Modifications" by Lt. Col. H.C. Mathews of U.S. Ordnance Dept. in Vol. 51, No.8 of the S.A.E. Journal for August, 1943.

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BASIC VEHICLE DATA

Too little thought was given in early planning to the matter of vehicle identification and records as vital to maintenance. Standardization in respect of model identification, separate serial number series by models, name plates, change point records, etc., would have saved much difficulty later.

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WARRANTY

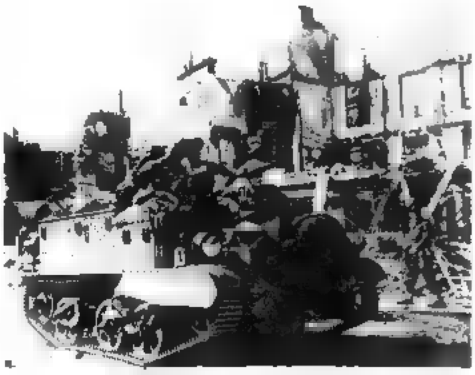
An attempt was made at the start to carry the equivalent of standard commercial warranty practice into military procedure. This was not successful and, although the occasional engine, etc., was dealt with in this way in Canada throughout the war, the system was not much used.- Experience proved that, by and large, warranty was best handled in a centralized manner through the Service Replacement procedure previously discussed. A suitable warranty clause was retained in basic contracts as a protection against defective equipment.

FIELD REPRESENTATIVES

As the war progressed a need was felt by the British for the help of specialists in the maintenance of Canadian vehicles. Arrangements were therefore made with Ministry of Supply to send direct Representatives from each manufacturer to the various theatres, where they worked in conjunction with Army Maintenance Organizations. The integration of these commercial civilians into Army organization entailed certain early difficulties, and considerable discussion arose from time to time as to the best handling of this generally approved activity. The conclusions reached by A.E.D.B. correspond essentially with those given in CFRS Report No.66 referred to below (Items 97&98). It is considered, however, that the plan should have been supplemented by regular survey visits by A.E.D.B. personnel.

FIELD COMMENT

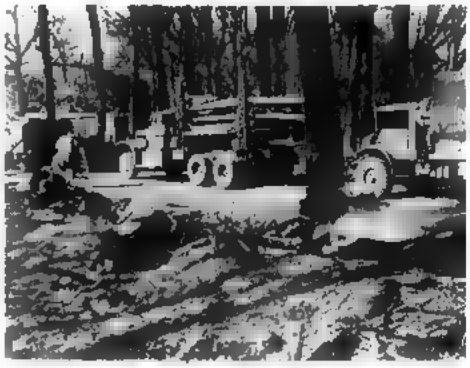
The latest comments by ultimate Users on items dealt with by Service Engineering Section are contained in I Canadian Field Research Section Report No.66 - R.C.E.M.E. Series No.2, "Report on Wheeled 'A' and 'B' Vehicles" under date of 12 August 1945, to which reference is directed.- Starting on page 36, items 87 to 98 inclusive give answers to queries placed by Service Engineering Section on the following subjects: VEHICLE LITERATURE; VEHICLE MAINTENANCE; FIELD MODIFICATIONS; TECHNICAL REPRESENTATIVES.



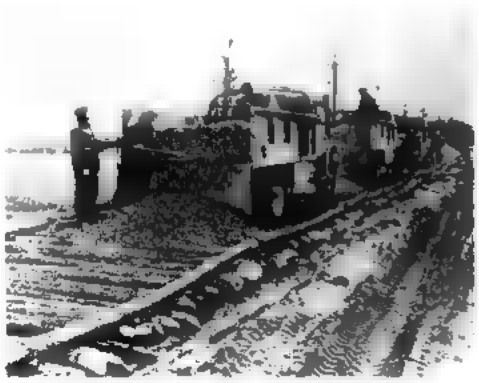
Universal Carrier - France

C.M.P. 15 Cwt. G.S. - France

C.M.P. 3 Ton 4 x 4 G.S. - N.W. Europe



Folding [redacted] Equipment Lorry - Holland

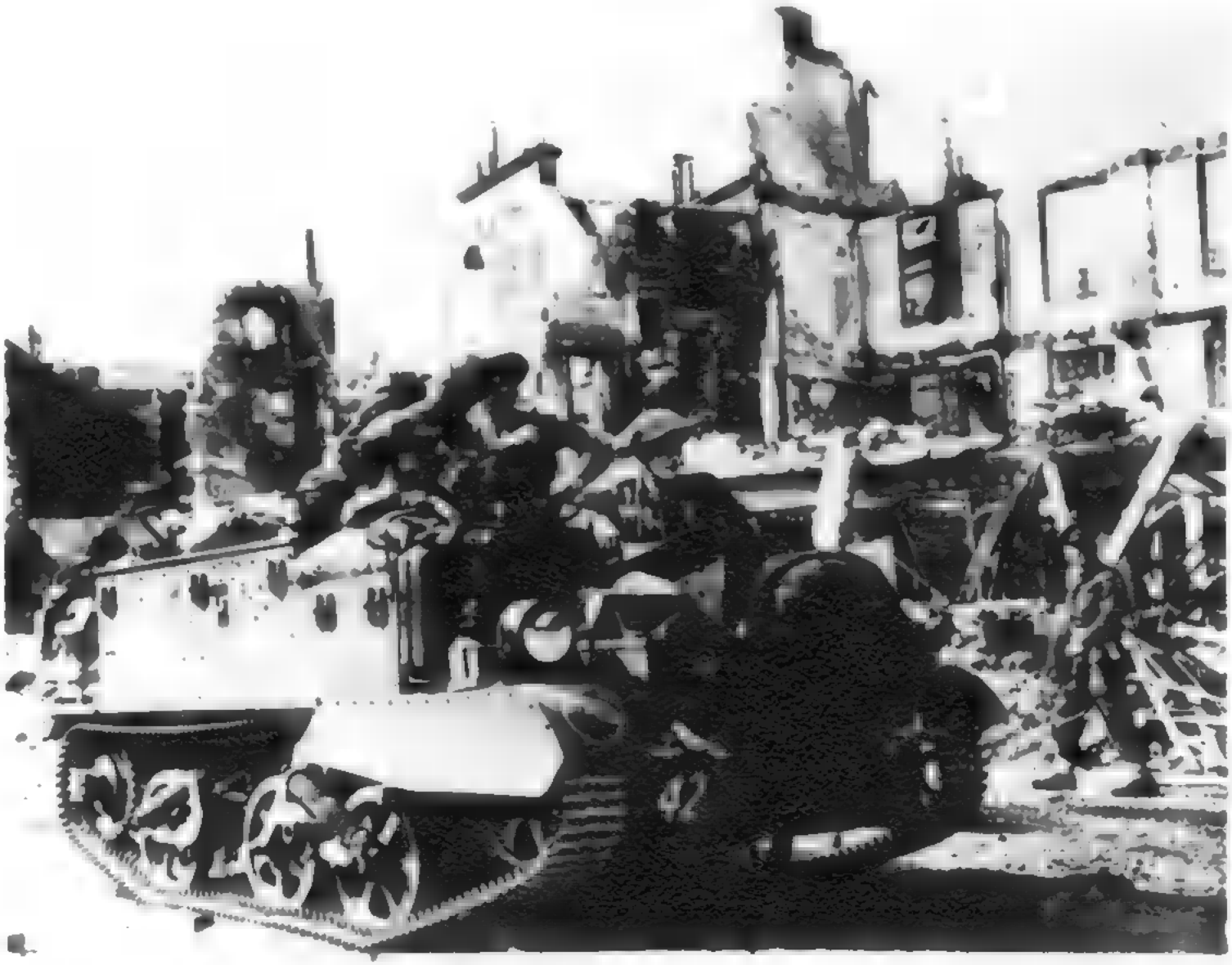


C.M.P. 3 Ton 4 x 4 G.S. - Belgium

C.M.P. Heavy Utility - Italy

C.M.P. Convoy Crossing Rhine, Germany

C.M.P. 8 Ton 4 x 4 S.P. Bofors - United Kingdom



Universal Carrier - France

C.M.P. 3 Ton 4 x 4 G.S. - N.W. Europe

C.M.P. 3 Ton 4 x 4 G.S. - Belgium

C.M.P. Convoy Crossing Rhine, Germany

C.M.P. 15 Cwt. G.S. - France

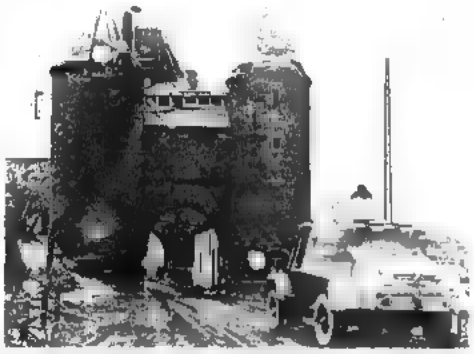
Folding Boat Equipment Lorry - Holland

C.M.P. Heavy Utility - Italy

C.M.P. 3 Ton 4 x 4 S.P. Bofors -
United Kingdom

15 Cwt. Armoured Truck - France

C.M.P. L.A.A.T. - France



Reconnaissance Car (Otter) - Germany

15 Cwt. Armoured Truck - N.W. Europe

Units of Can. Armoured Div. - Germany

C.M.P., F.A.T. - North Africa

Signals Line Construction Lorry - Belgium

C.M.P. Earth Auger - Belgium

15 Cwt. Armoured Truck - France

Reconnaissance Car (Otter) - Germany

Units of Can. Armoured Div. - Germany

Signals Line Construction Lorry - Belgium

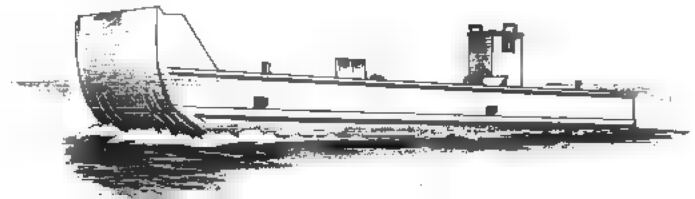
C.M.P. L.A.A.T. - France

15 Cwt. Armoured Truck - N.W. Europe

C.M.P., F.A.T. - North Africa

C.M.P. Earth Auger - Belgium

MISCELLANEOUS PROJECTS



MISCELLANEOUS PROJECTS

As already stated this record is broken down into a number of volumes. Subsequant volumes to number I are classed into vehicles of different function. However there [redacted] a large number of projects for which Army Engineering Design assumed responsibility and which were of such varied character that for reference purposes a short resume of the more important items is recorded below.

A. Snow Traversing Aids for Wheeled Vehicles

Considerable experimentation was made on auxiliary type equipment for wheeled vehicles, which would assist them in traversing areas of relatively deep snow. This equipment [redacted] not of the traction type such [redacted] chains.

Three items were investigated (a) Pusher Bar, (b) Snow Blade, (c) Snow Blade 'V' type.

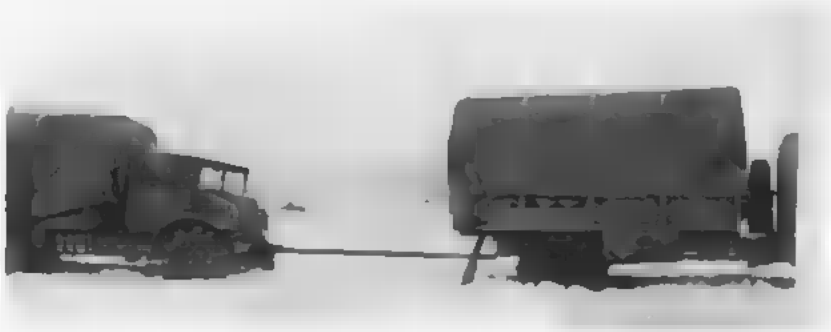
(a) The pusher bar consisted of a 12'-0" steel tubular member with [redacted] suitable lunette on one end and a universal joint and attaching flange at the other. It [redacted] found to be of considerable help in breaking trail in deep snow, and [redacted] placed between two vehicles as a draw or pusher bar, being fast to the towing hook of the front vehicle and to the bumper of the rear vehicle. Details are recorded on D.M.&S. plan S-1-CSK.

(b) C.M.P. 4x4 - 3 ton vehicles when fitted with tire chains were quite successful in moving cross country at a limited speed through snow up to a depth of 18 inches. Beyond this depth the vehicles tended to bogg down due to clearances. It [redacted] felt that some means of dissipating snow of from 6 to 12 inches above this depth might prove useful in some operations.

A Snow Blade was developed for application to the front bumper of [redacted] ton vehicles. It was designed for one operating position vertically but was made to adjust to two positions laterally. Details are recorded on D.M.&S. Schedule S-30-CSK.

(c) A light 'V' type manually operated [redacted] deflector [redacted] developed having a width of plough of 7'-6". It was adjustable to two positions vertically and records of details are shown on D.M.&S. Schedule S-60-CSK.

While none of the above equipment reached production, details were forwarded to U.K. for their information along with the report on tests carried out in Canada. Correspondence [redacted] this is recorded in D.M.&S. File 73-V-16, and E.E. Report Snow Traversing Trials Ottawa, 1942-43.



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COMOX TORPEDO

National Research Council and the Army Technical Development Board of Dept. of National Defence co-operated in 1943 in the production of pilot smoke laying craft. Early in 1944, Army Engineering Design Branch was approached to examine the records of these pilots and to prepare suitable specifications so that manufacturing could proceed.

This machine consisted of a light expendable marine craft powered by an internal combustion engine, fitted for automatic steering and with fusing arrangement to ignite a smoke cartridge at a predetermined time. It was a high speed craft fitted with hydro fails and presented a relatively small target. There was no crew required to ride in the craft.

The reader is referred to D.M.&S. File No. 73-C-26 for further details and to the National Research Council where plans are retained.

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WHEELS WITHOUT RESILIENT RUBBER

At one stage of the war, due to the forecast shortage of rubber, much time and effort was expended on investigating the available designs of wheels considered as possible applications for M.T. vehicles. This investigation included the piloting of metallic wheels with hardwood tires, and all metal wheels for Bofors Gun Mount.

Tests were run in limited quantity and while reasonable results were observed for slower speeds of vehicles the production of such wheels was never reached as synthetic rubber gradually became available in quantity. Further information is recorded in D.M.&S. file No. 73-W-4 and E.E. Report No. 22.

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LIGHTERS

Department of National Defence and subsequently the Ministry of War Transport required a number of Beach landing craft which could be readily knocked down and reassembled in various operational areas. The design and fabrication of the hull was handled by other agencies while the power plants and allied components were the responsibility of Army Engineering Design Branch.

These craft were barge type and usually were fitted with two power plants, each with its own propeller. Much effort was required to produce designs suitable for Canadian manufacture as dependence on availability of U.S. components was not safe.

Subsequently three designs of power plant were developed:-

1. That incorporating a Canadian Chrysler Automotive Engine with a Buchanan reverse gear and Simpler reduction Gear.

2. U.S. Chrysler Crown Marine Engine with Chrysler reduction gear and reversing mechanism.

3. A U.S. Gray Marine Engine.

The information in this regard is recorded in D.M.&S. File No. 73-1-109 and E.E. Report E 59.

FLAME THROWERS

In co-operation with the Directorate of Chemical Warfare and Smoke of the Department of National Defence various developments were undertaken by Army Engineering Design Branch. Some reached production while others were pilot developments only.

The Ronson Lighter was a type developed from a British Pattern, using liquid fuel. This pattern was produced in some quantity, and for further data the reader is referred to D.M.&S. File 73-3-75 and to Specification O.A. 120. The plans are on file with Army Engineering Design Branch - Contractor Stewart Warner Alemite Corporation, Belleville.

A Barracuda Lighter was piloted from basic British designs, by Stewart Warner Co. but no production order was fulfilled. Data is recorded on D.M.&S. File 141-18.

A further type lighter, Rattlesnake, was pilotted. This lighter was designed to use a Gell type fuel. Production was not reached but data is filed under D.M.&S. File 141-20. Two contractors Otis Fensom and Stewart Warner were consulted in this development. Plans of Rattlesnake Lighter are in D.M.&S. files.

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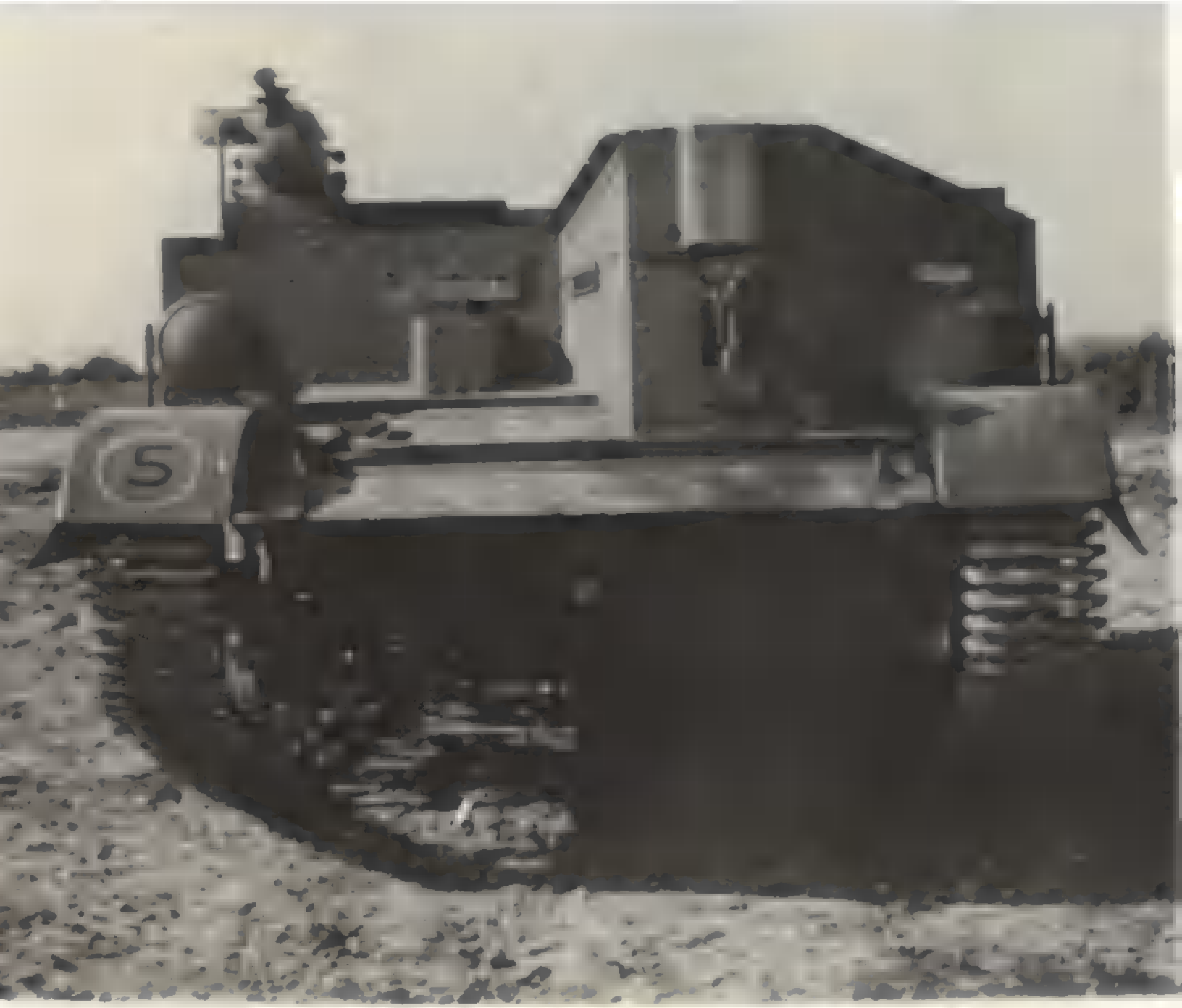
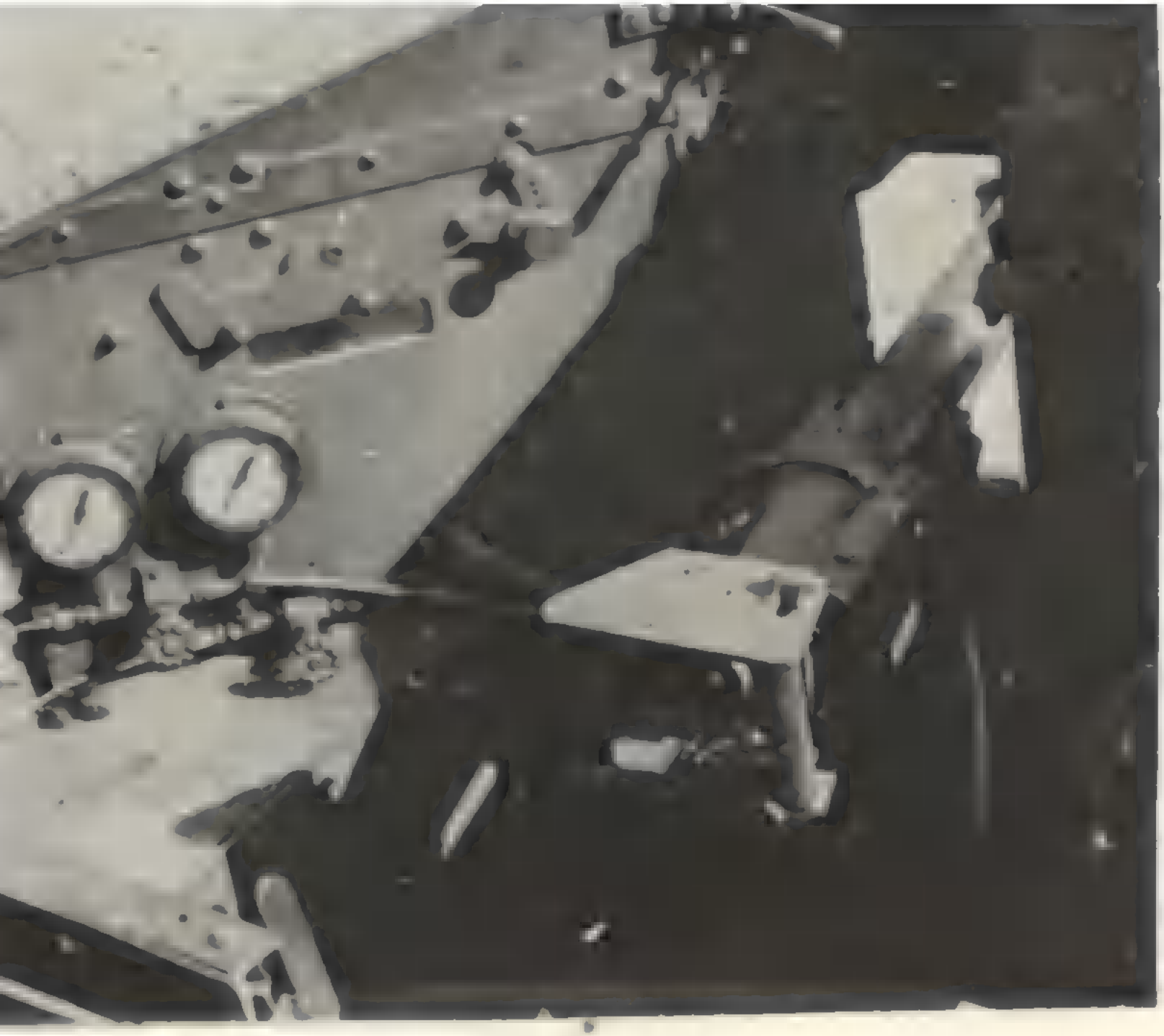
SMOKE EMITTERS

On the Universal Carrier a development took place to provide a smoke emitter. Pilots were produced but no production quantities were built. It consisted of discharging suitable fuel into the exhaust system of the vehicle. Data is recorded in D.M.&S. file 73-1-103.

RONSON LIGHTER ON UNIVERSAL CARRIER



BARACUDA



RATTLESNAKE

INSULATED FOOD CONTAINER - HALF GALLON

The British Army used an insulated Tea Can of one gallon capacity. Using this as a basis a development was started on a more efficient, less capacity, and large mouth type container suitable for either liquid or solid food. The provision of Snow Traversing vehicles laid further stress on the necessity for such.

After some research and development Food Containers were furnished to the production Armoured Mark I Snowmobile. Test results are indicated in National Research Council report P.H.C.-273; and further correspondence is filed in D.M.&S. File 73-V-16.

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MUMMY TYPE SLEEPING BAG

The requirement for a light efficient sleeping bag became apparent with the provision of Snow Traversing Vehicles. A mummy type bag was developed to specification O.A. 248 and produced by Holdens Ltd. A Report on tests of this bag is recorded in A.E.D.B. Report E-380 and E.E. Report 349.

S.P. GUN MOUNTS

Several projects reached pilot stage which were never placed into production for various reasons.

A [redacted] pdr. installation was developed for the armoured car chassis.

A 2 pdr. installation [redacted] also made on the Scout Car.

2 PDR ON SCOUT CAR

ARTILLERY TARGET TOWING WINCH

At the request of the Directorate of Artillery, Army Engineering Design Branch undertook the design of a winch, to be installed in a type VI R.C.A.F. Range Boat and to be used for winding-in and paying-out of a Coastal Artillery Target known as the C No. 2 Mk.I.

The specification for this winch is as follows:

1. To have a maximum line speed of 880 ft./minute, with a line pull of 600 lbs.
2. Winch drum to be capable of holding 3000 ft. of 1/8 inch diameter steel cable.

Due to space limitations in the boat, it was found necessary to install the winch in the passageway between the two boat engines. This imposed a severe space limitation as the width of the passageway is 18 ins. It was decided therefore to place the clutch inside the winch drum. A machine tool type of clutch was used. This made for compactness and the total width of the winch did not exceed 18 ins.

Several parts, including the winch drum, cover plates and bearing retainers were made of cast steel, making for lightness and strength. The main bearing journals are equipped with roller bearings and the winch drum with Timken roller type bearings. All small, exposed parts are made of stainless steel or are cadmium plated.

The winch is controlled by a single lever, located on an extension of the base channel section. There are three positions of this lever, brake, neutral and engaged.

The engine chosen was a Wisconsin, Model VE-4, 4 Cylinder, air cooled, gasoline unit. Drive from the 4:1 reduction gear on the engine is by 4, "B" section V belts. The engine is equipped with a locking type of hand throttle and a tachometer.

To insure even paying-on of the cable to the drum, a tensioner device was fitted to the Sampson post on the boat. This device consists of a series of 5 small diameter (3 ins.) ball bearing pulleys, with offset centres. The cable is threaded through the pulleys, which then impart tension to the cable.

Two of these units were made. As far as possible commercial units were used but practically all parts peculiar to this design were fabricated by R.C.E.M.E. Workshops in Ottawa. The reader is referred to D.M.S. File 73-W-16 and D.M.S. Drawing Schedule 320900.

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ARMOURED TRAIN

Late in the first quarter of 1942 the need for an Armoured Train by D.N.D. was made known to Army Engineering Design Branch and work started immediately on an 8 unit train composed of

1. Units 1 and 8. Steel Gondola cars, each equipped with one 75 mm. Ordnance piece, ammunition stowage, searchlight and Diesel generator including stowage of spares for each item.
2. Units 2 and 7. Steel Gondola cars, each equipped with two 40 mm. Bofors anti-aircraft weapons, ammunition racks and gun spares.
3. Units 3 and 6. Steel Box cars, each equipped with Infantry Detachment rifle racks, stowage for 2 inch and 3 inch mortars, Boys anti-tank rifles, and ammunition racks, cooled watertanks with main reservoir supply, toilets, and aerial observation posts.
4. Unit 4. Steel Box car equipped with commissary for 200 personnel, wireless room, medical operating room and an office for the railway conductor and Officer Commanding the train.
5. Unit 5. Motive Power. An oil burning locomotive with the cab portion covered

2 PDR ON SCOUT CAR

with armour plate [redacted] used as [redacted] temporary unit while a Diesel electric locomotive was being fitted out. This Diesel electric locomotive was developed by applying an Electro-Motive 16 cylinder engine to [redacted] Beardmore chassis. The chassis was resurrected from the scrap dock and now represents [redacted] modern locomotive.

All vulnerable train running gear such as air brake equipment, journal boxes and drawbars were protected by armour plate. The sides of all Gondola cars had 30 ins. of armoured protection in addition to approximately 75% end protection. The Box cars were armoured to [redacted] depth of 6 ft. 1-3/4 ins. above the floor level on both sides and ends. The Diesel electric locomotive was fully armoured.

A two way telephone system was installed which permitted conversation between any of the units.

Machine guns were stowed in each train unit with ammunition and spare parts.

Safety chains were used to prevent cars being uncoupled by unauthorized use of drawbar operating handles and two-way hinged armour plates used [redacted] protection for railway operating gear between the cars.

The work was performed by C.N.R. in their shops at Transcona, Manitoba. Delivery of the units were, seven in July 1942, one in August 1942 and the diesel locomotive in 1943. Data is recorded in D.M.&S. File 73-3-73.

TRAIN LESS UNITS 4 AND 5

LOCOMOTIVE

LOCOMOTIVE ARMOURED

GONDOLA WITH PROTECTED JOURNAL BOXES

PROTECTED DRAWBAR

GONDOLA INTERIOR STOWAGE

OBSERVER AT ANTI AIRCRAFT DEFENCE POST

RECORDS

LIST OF DATA
COMPRISING RECORDS OF
ARMY ENGINEERING DESIGN BRANCH

I. SPECIFICATIONS

Specifications issued by the Army Engineering Design Branch covered Vehicles and Related Equipment, they all carried the prefix "OA" and comprised the following:-

Number	Description	Remarks
1	Motor Cycles (Norton).	Obsolete see OA 66
2	MT. Vehicles - Bodies, General.	Obsolete see OA [illegible] and 86
3	Standard Commercial 2 Ton Truck.	Obsolete
4	MT. Vehicles Painting and Upholstery.	Obsolete [illegible] 76
15	Arcticized Compressor (1942 Design).	[illegible] 116
16	Standard Commercial Panel 1/2 Ton 4 x 2 - 112" Wheelbase.	Obsolete
17	4x4 F.A.T. Chassis only L.W.T.	Obsolete [illegible] OA 65
18	4x4 - 30 Cwt. Load Carrier Chassis, Cab.	Obsolete [illegible] OA 65
19	4x4 - 3 Ton Load Carrier Chassis.	Obsolete [illegible] OA 65
[illegible]	Leyland Tractors, conversion of.	Obsolete
21	Anti Aircraft and Medium Artillery Tractor.	Obsolete [illegible]
[illegible]	Cars, Staff, Light, R.H.D.	Obsolete [illegible]
23	Station Wagon R.H.D.	
[illegible]	Station Wagon R.H.D. British type.	Obsolete
25	Military Transport Vehicle.	Obsolete
[illegible]	Stores Lorry (UK) Body and Equipment.	
27	Tank, Petrol, 650 Gal. for 3 ton, 134" W.B.	
28	Tank, Petrol, 800 Gal. for 3 ton, 158" W.B.	
29	Generator Sets 20 K.W. for A.A. Searchlights for mounting on 2 Wheel Trailer.	
30	Winch.	Obsolete see OA 51
31	Ropes, towing.	Obsolete see drawings
32	Tire Chains	Obsolete see drawings
33	Bodies, Steel M.T. Vehicles.	
34	Bins X Y Z type.	Obsolete
35	Portable Battery Charging Plant.	Obsolete
36	Cartons.	Obsolete
37	4.7 Gun, C.P. Mounting.	
38	Bodies, Workshop and Stores.	Obsolete
39	Truck, Panel Type.	Obsolete
40	Truck Line Construction - (Signal).	Obsolete see OA 140
41	Derrick Legs.	Obsolete see OA 59
42	Body Engineers.	Obsolete
43	Cartons for "X" type bins.	
44	Wrecking Crane.	Obsolete
45	Motor Cycle, Solo [illegible] continuation 74-cc.	Obsolete
[illegible]	Garden Lloyd Ford Conversion.	Obsolete
47	Lorries, 30 cwt. and 3 ton commercial.	Obsolete
48	Compressor Equipment, for Engineers Unit.	
49	Motor Cycles, Solo and combination 45-cc.	Obsolete see OA 66
50	Motor Cycles Service type.	Obsolete see [illegible] 66
51	Winch, Commercial for Winch and Derrick Lorries.	
52	Cars, closed, heavy.	Obsolete
53	Standard Commercial 1-1/2 ton - 134" W.B.	Obsolete
54	Standard Commercial 1-1/2 ton - 158" W.B.	Obsolete
55	Standard Commercial 3 ton - 158" W.B.	Obsolete
56	Blackout Equipment for D.N.D. Vehicles.	Obsolete
57	Radio Interference Suppression.	Obsolete
58	Body, 10 ft. Winch and Derrick.	Obsolete
59	Poles, Derrick for 10 ft. Winch [illegible] Derrick Bodies.	
60	Engineers Winch.	Obsolete
61	Cars, Staff, Heavy - L.H.D.	Obsolete
62	Blackout Equipment.	
63	Tractor, Medium Artillery.	
64	3 Ton 6 x 4 or 6 x 6.	Obsolete
65	C.M.P. Vehicles, General Specification.	
66	Motorcycles.	
67	Blackout (Motorcycles).	
68	Winch, Workshop Body and Equi[illegible]t for 3 Ton.	
69	Conventional [illegible] Ton - 133" W.B. Special Body.	
70	Passenger Bus (28-30-32 Passengers).	
71	Station Wagon L.H.D.	
72	Cars, Light L.H.D.	
73	Truck, Panel Type 1/2 ton [illegible]ith Body.	Obsolete
74	Office Body 30 Cwt.	
75	Boxing [illegible] Packing Vehicles for Export.	
75A	Rustproofing, Packing, Boxing, Automotive Spare Parts.	
75B	Rustproofing, Packing, Boxing, Tank Spare Parts.	
76	Paints (Decontaminable) Paint-Painting Procedure.	
77	Fabric, Rubberised, gas decontaminable for Blackout Curtains.	
78	Low Loader Trailer, 16,000 lbs. capacity.	Obsolete [illegible] drawings
79	Transporters (16 ton) Trailer.	
80	Duck, Cotton Numbered, Water Rot Resistant.	
[illegible]	15 Cwt. Wireless Body.	Obsolete
[illegible]	Trailer-Semi-Mobile Laundry.	
[illegible]	15 Cwt. Water Tank Trailer.	Obsolete
84	Camouflaging - Painting.	Obsolete
85	Codes and Code Plates, Vehicles and Body.	
86	Bodies, G.S. Wood for M.T. Vehicles.	
87	Machinery Truck "KL" Body and Equipment.	
87-3	Machinery Truck "KL-3" Body and Equipment.	
88	Body, Dental, 3 Ton 4x4 - 158" Wheelbase.	
89	Trailer, Gas Welding, Body and Equipment.	
90	Trailers, Codes, Serials and General Requirements.	
91	Crane, Wrecking, 5-10 Ton, Power operated.	
[illegible]	Crane, Wrecking, 5-10 Ton, Hand operated.	
93	Tank, Rype Ram.	
94	Mobile Servicing Trailer, Body and Equipment.	
95	Trucks, Mod. Conventional.	
96	License Plates	Obsolete
97	Indian Motorcycles Tool Boxes.	Obsolete
98	Snowmobile, Bombardier.	
99	Arcticized Vehicles (-40°F./1942).	See OA 111 and OA 199
100	Light Utility (Bantam) Cars 4 x 4.	Obsolete See U.S.Spec.
101	Cars, Staff, Heavy, closed [illegible] door.	Obsolete

I. SPECIFICATIONS (CONT'D)

Number	Description	
102	Welding [illegible] Welding Symbols.	
103	Disinfector-Portable #3 (Cdn. Pattern).	
104	Ryps [illegible] II Tank.	Obsolete
105	Lubrication Specification, Tanks.	Obsolete see OA 216
106	Unit Maintenance Vehicle.	Obsolete
107	Rustproofing, Packing, Boxing for Spare Parts.	Obsolete
108	Disinfector for 3 Ton G.S.	Obsolete
109	Signal, Electric Trafficator.	
110	Earth Boring Machine, Power Driven.	
111	Arcticized Equipment Chassis and Cab (Russian Order).	
112	[illegible], Emitter, Exhaust type, Rear, Tank, Ram II.	
113	Rope, Cotton [illegible]isted Water [illegible] Rot Resistant.	Replaced by OA 117
114	Stationary Power Unit for Machinery Lorries.	Obsolete
115	Compressor Equipment for -20°F.	
116	Welding of Bullet Proof & Armour Plate, Armoured Traversing Vehicles.	
117	Rope, Hemp, twisted, water & Rot Resistant [illegible]" dia.)	
118	Workshop, Mobile (British Colonial Mission).	
119	Truck, Firefighting 3 ton, 4 x 2 - 158" W.B.	
120	Tractor, 3 ton, 105" W.B. for Semi Trailers.	
121	Batteries, Lead Acid, Storage, Low Temperature.	
122	Truck, 3 ton [illegible] - 159" L.H.D. (Dodge).	
123	Truck, 1 ton 4x2 - 130" L.H.D. (Dodge).	
124	Tank, Water, 200 gals.	
125	[illegible] ton conventional 4 x 2 Dump.	Obsolete
126	Tank, Water, 350 gals.	
[illegible]	Artillery Self Propelled, 40 MM. (Ford) Equipment.	
128	Carrier, Self Propelled, 40 MM. Mounting (Ford) Equipment.	
129	Truck Tractor 3-1/2 ton for Semi Trailer.	
130	Plastic tips for Webbed Straps.	
131	Arcticized Equipment (Diamond T) U.S.S.R.	
132	Painting - Interior of Jerricans.	
133	Tank, Water, 350 gals. Preventional Duties.	
134	Crane, Wrecking, hand operated 2-1/2-5 ton.	
135	Paint, Camouflage, for tarpaulin.	
[illegible]	Webbing, Cotton, W[illegible] [illegible] Rot Resisting.	
137	3/4 ton Truck [illegible] x 4 "Weapon Carrier".	
138	Slave Battery Charger, 1[illegible] Cwt. 4 x 4.	
139	Tires for Overseas, shipment of.	
140	Signal Line Construction, Lorry Body.	
141	Priming Paint for Metal.	See [illegible] [illegible]
142	Paint for Intermediate and Finish Coats.	See OA 76
143	Sealers for Wood.	S[illegible] [illegible] [illegible]
144	Priming Paint for Wood.	See OA 76
145	Heat Resistant Paint for Interior, Intermediate [illegible] Finish Coats.	[illegible] OA 76
146	Thinner for Paints.	See OA 76
147	Heat Resistant Paint for Exterior, Intermediate & Finish Coats.	[illegible] [illegible] 76
148	Tractor, Tracked - D6.	
149	Tractor, 4 tons for Semi Trailer (10 ton load).	
150	Tractors, Tracked, D8 - Caterpillar.	
151	6x6, 24,000 lbs. General Requirements	Obsolete
152	Truck, Tractor, 160,000 lbs. Train Load.	
153	Truck, Tractor, 73,000 lbs. Train Load.	
154	Tractor, Breakdown, 6x6.	
155	Truck, Tractor 4 ton 4x4.	
[illegible]	Stores, Body and Equip- [illegible] Lorry 3 ton.	
156-2	Stores, Mk.II, Body [illegible] Equipment for Lorry 3 ton.	
157	QMG-MT Maintenance Machinery Lorry.	
158	QMG Workshop	Obsolete
159	QMG Stores Lorry	Obsolete
160	Machinery "I" and CFP Charger, Body & Equipment.	
161	Battery Storage, CFP Body and Equipment for Lorry.	
162	Machinery "A", Body and Equipment for Lorry.	
162-2	Machinery "A" Mk.II, Body and Equipment for Lorry.	
162-3	Machinery "A" Body & Equipment for Lorry cold Temperature operation -40°F (USSR).	
163	Machinery "B", Body and Equipment for Lorry.	
163-2	Machinery "B", Mk.II, Body and Equipment for lorry.	
164	Machinery "C", Body and Equipment for Lorry.	
165	Machinery "A", Body and Equipment for Lorry.	
165-3	Machinery "D", Body and Equipment for Lorry Cold temperature operation -40°F (USSR).	
166	Machinery "DI" Body and Equipment for Lorry.	
167	Machinery "R E 7-1/2 KW" & Equipment for Lorry.	
168	Machinery "F", Body and Equipment for Lorry.	
168-2	Machinery "F", Mk.II, Body and Equipment for Lorry.	
168-3	Machinery "F", Body & Equipment for Lorry cold temperature operation -40°F (USSR).	
169	Machinery "H", Body and Equipment for Lorry.	
170	Machinery "I-30", Body and Equipment for Lorry.	
171	Machinery "J", Body and Equipment for Lorry.	
172	Machinery "L", Body and Equipment for Lorry.	
172-2	Machinery "L", Mk.II Body and Equipment for Lorry.	
173	Machinery "M", Body and Equipment for Lorry.	
173-2	Machinery "M", Mk.II, Body and Equipment for Lorry.	
173-3	Machinery "M-3", Body and Equipment for Lorry, Cold temperature operation -40°F (USSR).	
174	Machinery "25 KW" Body and Equipment for Lorry.	
175	Trailer, Multi wheeled, 90,000 lb. Payload.	
176	Trailer, Semi 45,000 lbs. Payload.	
177	Trailer, Semi 10 Ton.	
178	Press 60 Ton, Body and Equipment for Trailer.	
179	Brake Drum and Surface Grinder, Body and Equipment for Machinery Trailer.	
180	22 KW Generator Trailer.	
181	9 KW Generator, Equipment for 2 Wheeled Trailer.	
181-3	25 KW Generator, Trailer, 2 Wheel -40°F (USSR).	
182	Q.M.G. M.T. Auxiliary Trailer.	
183	25 KW Generator, Trailer 2 Wheel.	
184	Machinery "CZ Radio" Body and Equipment for.	
184-2	Machinery "CZ Radio, Mk. II, Body and Equipment for.	
184-3	Machinery "CZ-3" Body and Equipment for cold temperature operation -40°F (USSR).	
185	Machinery "Z", Body and Equipment for.	
185-2	Machinery "Z" Mk. II Body and Equipment for.	
185-3	Machinery "Z", Body & Equipment for cold temperature operation -40°F (USSR).	
186	Tractor, Breakdown, Heavy.	

1. SPECIFICATIONS (CONT'D)

Number	Description	Remarks
187	R.C.A.F. Maintenance Machinery Truck.	
188	Machinery "ZL", Body and Equipment for H.U.	
189	Petrol Tanker, Semi Trailer, 1500 Gal.	
190	Petrol, Bulk 800 Gal. Body & Equipment for.	
191	Canteen Body, for 3 ton 4 x 4.	
192	Bodies, Aluminum, for H.T. Vehicles.	
193	Tire Equipment for Dodge 3/4 ton Weapon Carrier.	
194	Paint, Primer, Surfacer.	
[illegible]	Plywood, for use in Army Vehicles.	
[illegible]	Rot Proofing for Hair or felt padding.	
197	Direct application, Rust-proofing Materials.	Obsolete see 04 75A
198	Protector, Tank Crew, Anti Gas.	
[illegible]	Arcticized Vehicles for minus 20°F.	
200	Carrier, Windsor, Mk. I*.	
201	Carrier, Universal.	
201A	Carrier, Universal No. 2 Mk. II.	
201-1	Carrier, Equipped, 2 Pdr.	
201-2	Carrier, Mortar Mtg. 3".	
[illegible]	Car, Scout, Mk III, Lynx I.	
202A	Car, Scout, Ford II, Lynx II.	
203	Car, Armoured.	
204	Car, Reconnaissance.	
205	Track for Tanks, Light, Mk VI B.	Obsolete
206	Track shoes for Tanks, Light, Mk VI B.	Obsolete
207	Plate, Armour, Bullet Proof, Welding of.	
208	Truck, Armoured, 15 Cwt. 4 x 4 G.M.	
[illegible]	Trailer, Bota.	
[illegible]	Lighter, Ronson, Performance Tests.	
212	Tank, Cruiser - Ram II.	
213	Tank, Cruiser - Grizzly.	
214	Pins, Steel Track, Universal Carrier Mk. I.	
[illegible]	Artillery SP-25 Pdr. Ram.	
[illegible]	Lubrication for Medium Tank, Grizzly I.	
217	Tank, Command and OP,	
218	Universal Scout Car.	Obsolete
219	Shoes, Track, Manganese Steel.	
220	Tank Mounting, 6 Pdr. Instructional.	
221	Periscope, Tank, C., R.H.L. (Vickers Type).	
222	Trailer, Cable Splicer, 10 Cwt.	
224	Mounting, Instructional 75 MM Gun (Tank Grizzly).	
225	Snowmobile, Armoured, Full Track.	
226	17 Pdr., Mk. II in Mid Gun Motor Carriage.	
227	Track Pins for Canadian Dry Pin Track.	
228	Ambulance, Armoured, 4x4(G.M.	
229	Tires, Carrier Bogie and Track Adjuster.	
245	Amphibious Truck Body, Light Metal Roadbearers and Platform.	
246	Tank, Water, 480 Gals.	
248	Bags, Sleeping - Mummy type.	
249	Padding, Crash.	
[illegible]	Power Plant for Power Propelled Lighters.	
250A	Power Plant for Power Propelled Lighters.	
251	Conversion of Existing Mounting, 9.2 inch Mk V to Mk VI and VIA.	
252	Tires, Blemished, Serviceable and Defective.	
[illegible]	Metal Beadlock, Hinged type.	
254	Special Air Compressor.	
255	Ferrous Metal Hardware Finishes.	
256	Specifications for Wood used in Superstructure.	
257	Aluminum Bronze Casting.	[illegible]
258	Jacks, Chassis.	
[illegible]	5 Ton 4x4 - 144" W.B. Prime Mover for R.H.L.	
[illegible]	Engine for Portable Air Comp, Sets.	
261	Portable Battery Charging Plant.	
[illegible]	Body and Hoist for Universal Tipper (4C2).	
[illegible]	[illegible] and Hoist for Universal Tipper (4F2).	
264	Priming Paint, Lt. Gauge Metal.	
265	Snowmobile - Armoured - Full Track, Mk II.	
266	Ambulance, Body, Stretcher Type.	
267	Crane, Sub-Base, Dominion, #350.	
269	"CZ" Mk IV Lorry (3 ton 4 x 4 Chassis).	
271	Machinery Lorry, Artillery Armament Repair.	
[illegible]	Machinery Lorry CFP for Battery Charging No. 3 for -40°F (USSR).	
278	Cable, Electric G.H.S.	
280	Machinery Lorry 9 KW-3.	Obsolete
281	Gas Welding Trailer "3".	Obsolete
[illegible]	Turret Assy.-Skink - 20 mm Quad.	
283	Tank Anti Aircraft 20 mm Skink.	
[illegible]	Electrical Hydraulic Traverse and Elevator Equipment for Tanks.	
286	Belleville Springs.	
287	Gasoline Engine, Radial, Reconditioning.	
300	Machineable Bullet Proof Material for A.F.V's.	

Note:- Master file of Specifications in Custody Central Registry D.N. H S. Copies current specifications in files Department of National Defense (Design Group).

2. VEHICLE UNIT LISTS

Vehicle [illegible] Lists [illegible] issued as supporting data to the specification for all "B" vehicles. The V.U.L. numbers were the same as the Vehicle Code [illegible] and are listed on reference charts under the following drawing numbers:-

Drawing Number	Vehicles Tabulated
B-34-SP	Trucks, Heavy Utility
B-35-SP	Trucks, 15 cwt. C.M.P.
B-36-SP	Lorries, 3 ton C.M.P.
B-37-SP	Trucks, 15 cwt. and Lorries 3 ton Modified Conventional.
B-20-SP	Trailers.

Note:- Master file of V.U.L.'s in Custody Central Registry D.N. & S. Copies current V.U.L.'s in files Department of National Defense (Design Group).

3. DESIGN CHANGE INSTRUCTIONS

Design Change Instructions were issued to Contractors and Inspection as a means of authorizing amendments to specifications as explained under Section "DESIGN CONTROL PROCEDURE". When the system was originated in August 1941 all D.C.I.'s were included in the one series. Later to provide flexibility the series [illegible] sub-divided [illegible] indicated hereunder -

(a) Original Series

First issued in August 1941, no prefix, 1 to 272 inclusive.
Start of 1942, prefixed "42", 42-1 to 42-1184 inclusive.

(b) "B" Vehicles Series

First issued in July [illegible] comprised the following:-
B2-1 to B2-639 inclusive
B3-1 to B3-1701 "

[redacted] CHANGE INSTRUCTIONS (CONT'D)

(b) "B" Vehicles Series - Continued

B4-1 to B4-2612 inclusive
B5-1 to B5-571 "
B5-5000 to B5-5111 inclusive (Snowmobiles only.

(c) "A" Vehicles (Other Than Tanks) Series

First issued in July 1942 comprised the following:-
A2-1 to A2-699 Inclusive
A3-1 to A3-661 "
A4-1 to A4-498 "
A5-1 to A5-142 "

(d) Wireless Equipment Series

In [redacted] and in the early part of [redacted] the SIGNALS DESIGN was a Directorate of the Army Engineering Design and in this period issued the following D.C.I.'s:- (First issued in February 1942).
W2-1 to W2-162 inclusive
W3-1 to W3- 62 "

(e) Ram and Grizzly Tank Series

First issued in February 1942 comprised a numerical sequence TANKS-1 to TANKS-421 inclusive.

(f) Valentine Tank Series

First issued in May 1942 comprised a numerical sequence VALTANK-1 to VAL-[redacted] inclusive.

(g) Armoured OP and Command Tank Series

First issued in June 1943 comprised of a numerical sequence AOP-1 to AOP-17 inclusive.

(h) [redacted] Self-Propelled Sexton Series

First issued in March 1943 comprised of the following:-

SPT-1 to SPT-566 inclusive
SPT-1000 to SPT-1066 "
SPT-2001 to [redacted] "

(i) Skink Tank Series

First issued in January 1944 comprised of the following:-
Skink-1 to Skink-390 inclusive
Skink-1001 to Skink-1087 "

(j) Gun Mount Series

First issued in August 1942 comprised of the following:-
G2-1 to G2-7 inclusive
G3-1 to G3-2[redacted] "
G4-1 to G4-5 "
G5-1 only

(k) Miscellaneous [redacted] Design Series

This series was instituted in June 1943 to cover Tank Design items which did not fall into the specific series above and comprised the following:-
TD-1 to TD-22 inclusive.

(l) C.K.D. (Completely Knockdown Vehicle) Series.

This series was instituted to cover the [redacted] of specifications developed by the Ford Motor Co. of Canada and General Motors of Canada for vehicles ordered through their overseas affiliated plants. This series was first issued in June 1942 with prefix CKF for Ford issues and CKG for General Motors issues and consisted of the following:-

CKF 2-1 to [redacted] 2-113 inclusive
CKF 3-1 to CKF 3-132 "
[redacted] 4-1 to CKF 4-272 "
[redacted] 5-1 to CKF 5- [redacted] "

CKG 2-1 to CKG 2-76 inclusive
CKG 3-1 to [redacted] 3-45 "
CKG 4-1 to CKG 4-17 "
CKG 5-1 to CKG 5-14 "

NOTE:- Master files of all D. C. I.'s in Central Registry, D. N. & S. and in Department of National Defence (Design Group).

NOTE:- Master file of Design Change Requests which are referred to on D. C. I.'s and D. D. P.'s is available in Central Registry, D.N. & S.

4. DESIGN DEVIATION PERMITS

Design Deviation Permits were issued to Contractors and Inspection as authority for temporary deviations from specifications. The D.D.P. system paralleled the D.C.I. system to a large extent and D.D.P.'s were issued in the following series:-

(a) Original Series

First issued in September 1941, no prefix, 1 to 84 inclusive.
Start of 1942, prefixed "42", 42-1 to 42-183 inclusive.

(b) "B" Vehicle Series

First issued in July 1942 comprised of the following:-
B2-1 to B2-160 inclusive
B3-1 to B3-249 "
B4-1 to B4-431 "
B5-1 to B5- 18 "

(c) "A" Vehicles (Other Than Tanks) Series

First issued in July 1942 comprised of the following:-
A2-1 to A2-34 inclusive
A3-1 to A3-64 "
A4-1 [redacted] A4-38 "
A5-1 to A5- [redacted] "

(d) Wireless Equipment Series

Issued in [redacted] only as follows:-
W2-1 to W2-18 inclusive.

(e) Ram and Grizzly Tank Series

First issued in [redacted] comprised of the following:-
TANKS-1 to TANKS-118 inclusive.

(f) Valentine Tank Series

First issued in July [redacted] comprised of the following:-
VALTANK-1 to VALTANK-48 inclusive.

(g) Armoured OP and Command Series

Only two D.D.P.'s [redacted] issued in this series viz. AOP-1 and AOP-2.

(h) 25 Pdr. Self-Propelled Sexton Series

First issued in April 1943 comprised of the following:- SPT-1 to SPT-19 inclusive also SPT-1000 and SPT-1001.

(i) Skink Tank Series

First issued in 1944 comprised of the following:-
Skink-1 to Skink-191 inclusive
Skink-1000 to Skink-1087 "

NOTE:- Master files as for D.C.I.'s.

5. CHANGE POINT ADVICE NOTICES

Change Point Advice Notices were issued to Government Branches and the U[redacted] to report serial numbers of units at which changes authorized by D.C.I.'s on "A" and "B" vehicles were incorporated. This system [redacted] instituted in February [redacted] and consisted of a total of 148 notices issued in numerical sequence.

NOTE:- Master files as for D.C.I.'s.

6. DRAWINGS

Drawings prepared in A.E.D.B. drafting room and by Contractors for A.E.D.B. are all listed on "Drawing Schedules". A Schedule of drawings is prepared for each individual project i.e., for any body, trailer etc.

6. DRAWINGS (CONT'D)

These schedules are listed on reference drawings as follows:-

Drawing Number	Items Shown
B-1-SP	Bodies of the "1" series
B-2-SP	Bodies of the "2" series
B-3-SP	Bodies of the "3" series
B-4-SP	Bodies of the "4" series
B-5-SP	Bodies of the "5" & "55" series.
B-6-SP	Bodies of the "6" series
B-7-SP	Bodies of the "7" series
B-8-SP	Bodies of the "8" series
B-9-SP	Bodies of the "9" & "10" series.
C-20-SP	Trailer Assemblies, Chassis and Bodies.
C-44-SP	Armoured & Special Vehicles
C-45-SP	Special Equipment (Bodies)
C-46-SP	Special Equipment (Chassis)
C-47-SP	Special Equipment (Guns and Mountings).
C-48-SP	Special Equipment (Armoured Vehicles).
B-49-SP	Special Equipment (Miscellaneous.

NOTE:- The files of original tracings held in Department of National Defence (Design Group).

7. DATA BOOKS

Five series of Data Books were compiled as a reference of the types of vehicles and equipment available in production.

(a) Canadian Military Pattern Vehicles.
(b) Canadian Armoured Vehicles (Other Than Tanks).
(c) Canadian Manufactured Tank Type Vehicles.
(d) Canadian Modified Conventional Vehicles and Trailers.
(e) Canadian Technical Data [redacted] Department Tires and Related Components.

8. WEEKLY ACTIVITY REPORTS

Weekly reports [redacted] issued which outlined the progress of all projects. [redacted] reports were distributed throughout the Automotive & Tank Production Branch and the Army Engineering Design Branch. Excerpts from this report were compiled into a "C. G. S." report which was forwarded to the M. G. O. Branch and of which copies were sent to Ministry of Supply [redacted] British Army Staff.

[redacted] comments on each project were extracted from [redacted] report and recorded [redacted] the project. [redacted] there is available a history of [redacted] development of each project, copies of which are [redacted] file at Department of National Defence (Design Group).

9. MECHANIZATION LIAISON LETTERS

In order that the U. K., India, other Dominions and the U.S. would be kept informed of Canadian [redacted] developments a system of mechanization letters [redacted] instituted in May 1941. Originally the one Liaison letter covered all vehicle and related equipment developments. After the fourth letter these [redacted] issued in two series, the "A" series covering "A" vehicles and a "B" series covering all "B" vehicles. In all 18 letters were issued covering "A" vehicles and 17 letters covering "B" vehicles. These letters were distributed to appropriate officers in Canada, U.K., South Africa, Australia, India, [redacted] Zealand and the United States.

NOTE:- One master copy is in file of Department of National Defence (Design Group).

10. POST WAR DEVELOPMENT

Report on Post War Military Vehicle Design in Canada, Analysis and Recommendations (by Mr. R. E. Jamieson, Director General and Mr. W.C. Millman, Assistant Director General).

NOTE:- Copy on file Department of National Defence (Design Group) and D. M. & S. Central Registry.

11. PHOTOGRAPHIC (STILLS) FILES

A comprehensive file was developed of all vehicles indexed [redacted] follows:-

A1	to A11	Armoured Vehicles (Canadian).
AX1	to AX8	Armoured Vehicles (U.K.).
B1	to [redacted]	Self Propelled Gun Mounts (Canadian).
[redacted]	to [redacted]	Chassis of all vehicles except trailers.
D1	to D20	Trailers.
[redacted]	to X27	Bodies (Canadian General).
XX1	to XX5	Bodies (U. K. General).
F1	to F17	Bodies (Technical Canadian).
FX1	to FX4	Bodies (Technical U.K.).
G1	to G5	Miscellaneous.
[redacted]		Imported Units.
T1	to T7	Tanks.

NOTE:- This file with Department of National Defence (Design Group).

12. MOTION PICTURE FILES

In many instances it [redacted] found vehicle development could be better described by motion pictures and the following projects [redacted] covered in this [redacted] -

Cold [redacted] Tests - Kapuskasing, February 1942, "B" Vehicles [redacted] Carriers.

Cold Weather Tests - Kapuskasing, February 1942, [redacted] and Valentine [redacted].

Bombardier and G.M.3/4 Track Snowmobiles traversing various depths of snow and climbing grades.

Bombardier Full Track and Weasel in Snow and through 3' of water, at high speeds in soft snow and hard surfaces, towing trailer. Also some shots of G.M. without skis.

Combination of scenes from several films consisting of:- G. M. and Bombardier 3/4 track at high speeds over soft and hard surfaces, [redacted]ing 7' snow bank, wading. Also Armoured Snowmobile in mud and crossing ditch - Pusher Bar - Allis Chalmers Snow Plough - 6 ton semi on Figure eight (British Type fifth wheel) - Reese. Car on railroad ties.

Bombardier and G.M. 3/4 track snowmobile sprockets.

[redacted] of ½ ton 4x4 with [redacted] in snow, Pusher [redacted] and snow deflector on vehicles and in operation, Allis Chalmers Snow Plough in action and close-ups of various items used [redacted] traversing "B" vehicles.

Armoured Snowmobile in Snow, Mud [redacted] Cross Country (Fully Titled).

Universal Carriers showing Flame Thrower - Smoke Emitter and Track Pin Retainer.

Scout Car, Armoured Car and Armoured Truck on:- C.C. - [redacted] Hill - Belgian Blocks and Grades.

Tests conducted on [redacted] Ambulance:- Riding qualities of different type spring suspension. Also spring suspension of stretcher [redacted]

Ram Tanks:- Highway, Mud, C.C., Track Action over C.C. on Bogie Wheels, over Rock Pile, Grades and crossing Rocky Gap.

20 Ton Transporter showing:- loading - Rough C.C. trials and tractor and trailer Bogie Wheel action.

50 ton tank Recovery with Special chains - Loading Churchill tank on trailer using winch.

Spudded Tracks [redacted] M-4 and Sexton.

M-4 and Sexton with C. D. P. tracks and Rubber tracks climbing grades and rounding curves.

[redacted] Tank in Snow - T54E1 Track.

12. MOTION PICTURE FILES (CONT'D)

Churchill Tanks with:- Manganese, Stand- [redacted] Box and Ice Bar tracks, on snow and ice - at Camp Borden.

Military Tractors for Combat communication Supplies - High Speed Track laying vehicles.

Hortsman Suspension.

[redacted] Wheeled Drive.

Tank Track Experiment.

Wading Trials at Comox B.C.

Tire Testing [redacted] Normoyle, Texas.

NOTE:- This file with Department of National Def[redacted] (Design Group).

13. EXPERIMENTAL REPORTS

(a) The Experimental Section of [redacted] Branch prepared individual reports on each project [redacted] follows:-

Project No.	Description
E1	"Uni" Lubricating Guns.
E82	Effect on Vehicle of Wheels without Cushion Tires.
E48	2" Smoke Mortar - Armoured Car, Reconnaissance Car.
E57	A.P.V. Vision Port - De-frosting and De-misting.
E59	Power Lighter Engine Testing.
E60	Bolted Wood Body - Chrysler 3-Ton Chassis.
E62	65 H.P. vs. 95 H.P. Engines - Universal Carrier.
E64	Universal Carrier Idler Wheel.
E70	Armoured Car Steel Bins.
E71	Mitchell Chain Bracket.
E72	Willys 1/4 Ton 2-wheel trailer.
E74	Destruction Test - 15 Cwt. Bolted Steel Body.
E75	Air Tire Pump - (Defiance Alloyed Products.
E79	Observed Horse Power Curves - Chrysler 250.6 cu.in. Engine.
E80	Observed Horse Power Curves - Ford 239 cu.in. Engine.
E85	Marine Reverse and Reduction Gear Tests.
E86	Mounting Chains on Diamond T Tank Transporters.
E87	Cochrane Battery Terminal Connector.
E88	Willys 1/4 Ton Trailer converted to Carry 11 Cwt.
E89	Front [redacted] Drive "Lockout" Plate.
E90	[redacted] Wheel Snatch Block (D.W.).
E92	Photographs - Revisions to Reconnaissance Car.
E93	[redacted] Pilot Light Recovery Trailer.
E94	Interchangeability - 3-ton Ford and G.M. Rear Hubs.
E96	8" Ball and Socket, Universal Coupler (Fifth Wheel).
E96	Defiance Fully Enclosed Six Volt Tire Pump.
E98	(1) - "B" Vehicle Tool Kit - (2) New Wrenches Necessary.
E99	Copper Bearing Steel as Substitute for Terne Plate Steel in "B" Vehicle Fuel Tanks.
E[redacted]00	New Type Brake Seal - Ford - Universal Carrier.
E102	Sandguards - Carrier.
E105	Lloyd Non-Skid Attachments.
E105	Ford 6 Pdr. Portee.
E106	Willys 4x4 Jeep - Water Splash on Engine.
E107	Mounting of 30 and 50 Cal. Browning Guns.
E108	Illustrations of [redacted] Stowage Bins [redacted] Sun Compass - Scout Car.
E109	Water Drainage - Universal Carrier.
E110	"Uni" [redacted] to Lubricate C.M.P. Vehicles at -40°F.
E111	Willys Overland 4x4 Jeep Steering.
E113	Snow Traversing.

Project No.	Description
E114	Russian Non-Skid Track.
E116	11 Cwt. Trailer Train.
E117	11 Cwt. Composite Body - Two Wheel Trailer.
E120	6 Pdr. Portee (Gun Depression Stop) (Field Installation).
E121	Flanged Sprocket, Australian U.C.
E123	Comparison H. P. Curves Ford 258.4 cu.in. vs. Chrysler 250.6 cu. in. Engines.
E124	Tank - [redacted] [redacted] Emission.
E125	[redacted] Seal - Universal Carrier.
E126	2" [redacted] Thrower - Universal Carrier.
E127	Scout Car Windshield Defroster.
E128	2" Bomb Thrower - Armour[redacted] Car.
E130	Triplex Blocks.
E131	Pilot Note Trailer.
E132	Track Pinning Methods on Ram II Tanks using C.D.P. Track.
E135	[redacted] Track (Dominion Rubber).
E137	[redacted] Heater.
E138	Scout Car - New type Axles Assys.
E139	C.M. 6 Pdr. Portee.
E140	#932 Walker 5 Ton Hyd. Jack.
E142	Front [redacted] Lubrication.
E143	Sheet Metal Removal on C. M.P. Vehicles equipped with 2[redacted] [redacted]
E144	Application of Solenoid Control Firing Co-ax [redacted]hine Gun.
E145	Cold Weather Testing 1942-43 (K.V.A. Generator).
E147	Suitability of D. H. D. #510 brake fluid in temperature above 70°F.
E148	Use of Wheel Bearing Greases No. 2 and No. 0.
E149	Bracket-Magnetic Compass (Scout Car).
E150	Windshield Defroster - 12 Volt.
E151	Installation of 2" [redacted] Thrower - Armoured Car.
E152	Reworked Rzeppa Ball [redacted]
E155	F.W.D.4-Ton 4 x [redacted] Tractor and 10-Ton G. S. Semi-Trailer.
E156	Tru-lay Control Cable.
E157	20 Cwt. K.D. Trailer.
E158	Dead Man Switch.
E160	Bracket-Magnetic Compass - Armoured Car.
E162	Dodge C.M.P. 4x2 - 15 Cwt. Acceptance Test.
E163	Wood Instrument Panel Cushion Pads.
E164	Willard D.M.S. [redacted] Batteries.
E165	Dodge [redacted] 110L-6 4 x 2 Dump Truck (Tipping Body).
[redacted]	Canadian Dry Pin Track.
[redacted]	Standard Spliced Eye Cable vs. Malleable Socket Open and Closed End type Cable.
E170	20 Cwt. Trailer Body (British)
E171	15 Cwt. [redacted] x 4 Armoured Truck (see E-369).
E173	Weight Comparison Ford vs. Chevrolet 3-Ton - 156".
E174	Defiance Model 100 Tire Pump.
E175	Auto Specialties Jack No.1480.
[redacted]	Canadian Army Standard Tire Chains 900-16 - 1060-16 (vs. U.S. Army Light Weight Tire Chains).
E177	Removal of [redacted] Bar sub-assembly from Driver's Port and Installation of [redacted] Bar - Armoured Personnel.
E180	Cooling Differential of oil and water on Armoured Car Engine.
E181	Performance Test on U.C. - 95 H.P. and U.C. 65 H.P.
E182	[redacted] Ft. Personnel Transport Body.
E183	Ford 3-Ton [redacted] x [redacted] - 160" W.B.
E184	"Jeep" Truck Hand Brake [redacted] 15 Cwt. Trailer.
E185	Wiring Harness for Trailers.
E186	Bogie Tires with T-54E1 Track.
E187	Cooling differential of oil and Water of 65 H.P. Engine - U.C.
E188	Serviceability of 6-925-16 R.F. Firestone Tires.
E189	Ford Hand Brake Assembly on 15 Cwt. G.S. 2-Wheeled Trailer Chassis.
E190	Wooden Mock-up of Universal Scout Car.
E191	Removal of 2 Rear Seats from Arm'd. Truck 4x4, 15 Cwt. G.M. and install 2 Sten Gun Brackets.

13. EXPERIMENTAL [redacted] (CONT'D)

Project No.	Description
E192	Ford 15 Cwt. 4x4 with [redacted] Slope Windshield Cab.
E193	Heavier P.A.T.
E194	Walker Jack No. 942.
E195	Combination of Synthetic Tube and Flap (100% Synthetic).
E196	Make Bracket and Install on Armoured Personnel Half-Track Carrier (American Army).
E197	Wooden Mock-Up of Snowmobile Driver's Compartment.
E198	115" W.B. Ford 3-Ton 4x4 with 6 Long Ton Semi-Trailer.
E204	Adapting Lugs to Wheels of 10.50 x 20 size and 9.00 x 16.
E206	Cooling of Engine of Armoured Car (Caplad Development).
E207	Installation of Magnetic Compass Brackets on Armoured and Scout Cars.
E209	Road Test over Rough Terrain - House Type Ambulance.
E212	Heavy Utility Frame Side Rail Bending.
E213	Temperature Rise Tires on Tanks equipped with C. D. P. Rubber Block, T84E1 and T49 Tracks.
E214	[redacted] Steel Bogie Wheel for U.C.
E216	Mock-Up for 20 M/M. Gun.
E217	Performance Test on Armoured Car - Chrysler Engine.
E218	Weight of 10 Cwt.G.S. Trailer.
E219	Cooling Differential of Oil and Water on Armoured Car with Chrysler Engine.
E220	Brake Seal Photographs U.C.
E221	Weight of 20 Cwt. Trailer.
E222	S. P. Bofors Gun [redacted] and Chassis.
E223	6-Ton G. S. Semi-Trailer.
E224	Bogie Temperature Rise.
E226	G.S. Body with Adjustable Superstructure.
E227	Oil Consumption on R-975-C1 Engines.
E228	Field Hospital - Medical Officer's Body - 3-Ton.
E229	Low Temperature Greases in [redacted] Weather (revised).
E232	Bren Gun Spare Barrel Bin.
E233	Development of Light Chain A. F. Vehicle Wheels.
E234	Neoprene Wire Cord Cog Fan Belts - Chevrolet.
E236	Chrysler 331 cu. in. Engine in P.A.T. - Heavier Development.
E237	Seats - D.M.D. Cabs.
E238	Stretcher Supports - Ambulance.
E240	Drain Pipe to Diluter Can.
E242	Heavy Utility for Wireless Vehicles.
E245	20"x 9"x16"Steel Bogie Wheels.
E246	20" x 9" x 16" Heat Resistant Stock Bogie Tires.
E247	21" x 9" x 16" Bogie Tires.
E248	20" x 9" x 16" Synthetic Rubber Bogie Tires.
E249	20" x 9" x 16" Synthetic Rubber Bogie Tires.
E250	Test Courses - Testing Facilities available to E.E.Section.
E252	Production Pinning Track Pin Retention C.D.P. Track.
E253	C. D. P. Track made by Hull Steel Ltd.
E254	Heavy Utility Computer.
E255	C.D.P.Track with 15 1/8" Long Pins.
E256	C.D.P.Track with 15 1/8" Long Pins.
E257	Performance Test on 15 Cwt. Armoured Truck.
E260	Spare Tire Removal - Dismond T Model [redacted] or 981.
E261	Use of Pusher Bar Operating in Mud or Swamp.
E262	M.O. Vehicle.
E263	Canadian Dry Pin Track from Hull Steel Ltd.
E267	C.D.P. Track made by Electric Steels Ltd.
E268	C.D.P. Track made by Electric Steels Ltd.
E271	Spare Tire Carrier on 3-ton G.S. Body Mounted.
E272	[redacted] Ambulance.

Project No.	Description
E273	303 Ambulance.
E274	Universal Carrier Sprockets.
E275	Durability of Curtain Bags.
E276	Ford Front Spring.
E277	Ford Rear Spring.
E279	Low Temp.Batteries - DMS-21.
E280	Transfer Case Gear Jump-Out.
E280-A	Transfer Case Slip-out-of-Gear.
E281	Operation of H-Speed Transfer.
E282	Oil Filters with Heavy Duty Oil.
E283	Ford Cab [redacted] Motor Insulators.
E283-A	Cab Insulators, Engine Insulators and Rear Motor Support.
E284	Torque Maintenance - Universal Joint Flange Bolts.
E286	Rear Shock Absorber Link.
E288	Ford Radiator Mounting Kit.
E287	Valve Chamber Baffling.
E288	Ductiloy Frames - Ford 4 x 4.
E289	Spark Plug Test - Ford and Chev.
E290	Buna-S Rayon Cord Fan Belts.
E291	Chev. Front Spring Assembly, 15 Cwt. C.M.P.
E292	Voltage Regulators.
E293	Clutch Discs.
E294	GRS Rayon Cord Fan Belts.
E296	Front Spring Bearing Spacers - Trials on 5" and 6" Steering Joints.
E296	Durability of Exper.Radiator.
E297	Longitudinal Body Sills and Sill Fillers on SW1 Bodies.
E298	16" Divided Type [redacted] Clamping Bolts.
E300	Fuel Consumption G. M. [redacted] 270 cu.in. Engine.
E301	British Type Towing Hook.
E302	Canadian Manufactured Kota Trailer Tires.
E303	[redacted]. G.S. Body Adopted for Wireless Code 2-C-3.
E304	Traction Ability of Chains on Two Rear Wheels.
E305	F. W. D. Model H.A.M. Tractor Trailer, 6-Ton.
E306	6 - 6.00-2-D.M.D. Light Gauge Metal Split Wheels.
E307	Impact Brakes 60 Ton Press Trailer.
E309	F.W.D. Model H.A.M. 3-1/2 Ton Tractor, 6-Ton Trailer.
E311	Revised Tarpaulin 4 x 4 G.S. Two Position Superstructure.
E312	Climbing Ability of Tank Equipped with C. D. P. Track.
E314	Exhaust Type Rear Smoke Emitters - Stewart-Warner Alemite Corporation.
E317	Cold Starting of R-975-C1.
E318-A	Cold Starting of R-975-C1.
[redacted]	Winterized Kit Saxton.
[redacted]	Electric Steel C.D.P. Track.
E325	800 Gal.Petrol Tanker on 4-Ton [redacted] 156" W.B. Chassis.
E326	Track Tightening Wrench plus Crow Bar.
E327	Disc Type Bogie [redacted] on Universal Carrier Mk. I.
E329	Disc type Experimental Bogie Wheels.
E330	Barrel Protector - 2-inch Smoke Mortar.
E331	Weights Ford [redacted] Chev. 3-Ton [redacted] 156" W. B. Chassis and Cab and G.S. Body Complete.
E333	Synthetic Tires on Universal Carrier Bogie Wheels.
E336	C.M.P. Cab Wonder Curtains.
E336	Crash Pads - Scout Car Ford II, Lynx II.
E339	Windsor Carriers Performance and Reliability Tests.
E341	Synthetic Tires on Universal Carrier Bogie Wheels.
E342	Rubber Block Track and [redacted] Track on an M4 Tank on Rock Pile at P.G.
E343	Clutch Control Springs - U.C.
E344	T.C.V. Body Code 6Z2 - General Motors 6 x 6.
E345	T. C. V. Body Code 6Z1 - Ford 6 x 4.
E347	Reliability of Track Pins.
E348	Functioning of New Experimental 6 Pdr. Firing Gear.
E349	Sleeping Bag.
E353	Cable Splicing Trailer Body,

13. EXPERIMENTAL REPORTS (CONT'D)

Project No.	Description
E364	U. C. Bogie Spring Guide Rod Removing Tool.
E365	15-Cwt. and 30-Cwt. Trailer [illegible].
E366	Cold Test Stretcher Lifting Mechanism.
E367	Universal Tipper Body Model 4-C-2 - Design Proof Test.
E368	Cold Test Hydraulic Hoist Oil.
E369	15-Cwt. Armoured Truck Jerrican and P.O.W. Containers.
E360	Efficiency of Anti-Splash Protection Plates on Sexton.
E361	4C2 Universal Tipper Weights.
E362	15 Cwt. Armoured Truck Performance and Reliability.
E365	1500 Gal. Petrol Tanker - Ford 4 x 2.
E365-A	1500 Gal. Semi-Trailer Type Petrol Tanker.
E366	Drawbar Location Overhanging Body 3-Ton.
E367	Foot Operated Tire Pump.
E368	Track Operating in Snow and Ice when installed on a Medium M4 Tank.
E369	Track Adjustment - [illegible] and Sexton.
E371	Comparison Standard F.A.T. vs. Heavier F.A.T.
E375	Superfex Model 400 Thermosyphon Engine Heater.
E377	60-L-Dent-2 3-Ton Dental Lorry - Approval Data Sheet.
E378	600 Gal. SW2 Petrol Tank mounted on Dodge 3-Ton 4 x 2.
E379	Ford Engine 60 lb. Pump Valve Compartment Baffling.
E380	Sleeping Bag - Cold Room Test.
E381	Tools for Maintenance [illegible] 15 Cwt. Armoured Trucks.
E382	Motor Cycle - Relocation Tail Light Wiring.
E383	Dominion Foundries and Steel Co. C.D.P. Track Shoes.
E384	Rev.1 - 15 Cwt. Mounted 20 MM. Automatic Gun - Body 2-L-1.
E385	Goodrich Outsize Fan Belts.
E386	Cable Layer (Composite) Code #3K-1.
E388	Hollebone [illegible] Bar [illegible] Towing Attachment.
E389	Auto Specialties 5 Ton Mechanical Chassis Jack.
E390	Rear Smoke Emitters. Spec. C.A. 112 - Ram and Sexton.
E391	15 Cwt. House Type Wireless Body Code 2-K-1.
E392	Safe Line Wire Rope Clamps.
E393	Splash Protection Strips - Sexton S.P. 25 Pdr.
E395	Rolling Resistance - Universal Carrier, Windsor Carrier.
E396	3-Ton Dodge 4x2 Modified for 10.50 x 20 W.D. Tires.
E397	Expanded Metal Panels - Anti-Grenade - Ford II, Lynx II.
E398	[illegible] Strap Substitute for Springs - C.M.P. Seat Backs.
E400	Rolling Resistance Scout Car, Ford II, Lynx II (Canadian).
E401	Recoil Interference Investigation - 25 Pdr. Sexton.
E404	C.M.P. Side Lamp Visibility.
E405	Mounting Machine Gun Bracket.
E406	Data Sheet 10 Ft. Office Body SE3.
E407	M C 2 Universal Tipper Data.
E408	Driver's Door 25 Pdr. Sexton, S.P.
E409	Individual Bogie Wheel - Sexton 25 Pdr. S.P.
E411	Auto Specialties 5 Ton Ratchet Jack.
E412	Earth Auger Unit Code M M 1.
E413	Hydraulic (Door Closer Stretcher Support 303 Ambulance).
E414	Truck Armoured 15 Cwt. 4 x 4 Lighter Fuel Tank Covers.
E418	Snowmobile, Armoured, Tracked Mk. I - Driving Member Gear Lubricant Trials. Part III - Final Trials - (Dynamometer).
E417	Truck, Armoured 15 Cwt. 4x4 - Bolted Type Jerrican Brackets.
E419	Life Test Homelite Auxiliary Generator.

Project No.	Description
E420	Performance Trials - 15 Cwt. Truck, Armoured.
E422	6-K-4 Petrol Tanker 800 Gal.
E423	Gradeability 25 Pdr. S.P. Mount (Sexton).
E424	Aluminum Stretcher Rack Ambulance, 3-C-1.
E425	Stowage Model 361 3-Ton Ambulance.
E427	Service Removal, Chev. Engine.
E429	[illegible] Emitter - Universal Carrier (6 Volt 3 Piston Pump).
E430	Special Equipped Ford Engine (Oil Consumption Test).
E431	Light Weight One-Gallon Oil Can Carrier.
E433	Ford Engine Revised Pistons, Rings and Bearings - Scout Car.
E434	Special Bearings and Pistons, - Ford Scout Car Engine.
E437	4-C-2 Universal Tipper Pistons with Bevelled Grooves.
E441	Synthetic Bogie Tires - Universal and Windsor Carriers.
E443	Commander's Caravan SW3.
E445	Sexton Item Stowage Weights.
E446	Tunneling Company Compressor.
E447	Photographs of C. D.P. Track.
E448	D. W. D. 681 as Lubricant for Windshield Wiper.
E449	Scout Car, Lynx II, Manually Controlled Declutchable Fan.
E451	Traversing [illegible] Indicator on Sexton 25 Pdr.
E452	Burman Steering Damper Type #1.
E453	Tire Chains, [illegible]ess Type.
E454	8-Ton Flat Floor Trailer Body.
E456	8-Ton Flat Floor Trailer Body.
E457	Servicing and Repair Accessibility for Driver's Tanks and 1st. Echelon Repairs.
E458	Air Portable 15 Cwt.
E461	Performance Trials - Welsh Guard Carrier.
E462	Wide Malleable Iron Idler Wheel.
E463	Auto Specialties Jack.
E465	8-Ton Pipe Bolster Trailer.
E467	D.M. & S. Drawbar B 11078.
E468	Experimental Transfer Case - Comparison (see also E506).
E470	SW3 Pilot Signals Office Lorry.
E471	Light Gauge Wheels.
E472	Dodge 15 Cwt. 4x2 Seat Cushion.
E473	Heat Transfer to Battery Compartment - 25 Pdr. S.P. Sexton.
E474	Field Artillery Tractor (Soft Top) S/T33/Pilot.
E476	Drag Line and Crane, Mounted on Mack 10-Ton.
E479	8-Ton 4-Wheel Trailer Chassis.
E480	Sextons - Rear Idler Bearings.
E482	Sexton C. D. P. Track Pin.
E483	Snowmobile, Armoured Mk. I, Cold Starting.
E484	Windsor Carrier - Fuel Tanks.
E485	Hoof "Brake Eye" Device for Hydraulic Brakes.
E486	Universal Tow [illegible] (Exper.).
E490	Stowage "Skink" Weights of.
E491	3-Ton C. M. P. Long Wheelbase Airborne.
E492	Data - Slave Battery Charger, 15-Cwt.
E493	Comparison of Mineral [illegible] H.D. Oil on Homelite Engines.
E494	Neoprene Dust Excluders (Carriers.
E495	Experimental Over-Roof Exhaust - Ford Ambulance.
E496	Comparison of Resistance on [illegible]ious Tanks and Sexton Tracks.
E497	Scale of Weights F.A.T. (7S2).
E498	Performance Trials P. W. D. Model H.A.R. Exper. F.A.T.
E499	D.M.D. Winch Weights.
E500	Drawbar, 10 Cwt. Trailers.
E501	Koroseal Coated Steering Gear Cover (Carriers).
E502	Titeflex [illegible] Pipe - Windsor Carrier.
E503	Dodge 3/4 Ton 4x4 Ambulance.
E504	Riding Comparison Dodge 3-Ton & Standard Canadian Ambulance.
E505	Sand & Snow Packing on Idlers - Sexton 25 Pdr. S.P.
E506	Experimental Transfer Case - Comparison (see also E.468).
E507	2-Ton 4-Wheel Trailer Pilot Model Approval Data Sheet.

13. EXPERIMENTAL REPORTS (CONT'D)

Project No.	Description
E508	Data Sheet - 3-Ton C.M.P. Chassis with 5W1 - 12' Steel Body.
E509	Light [redacted] Amphibious Truck Body.
E510	Aluminum W.D. Divided Wheels.
E511	C. D. S. Dominion Synthetic Bogie Tires - Sexton 25 Pdr.
E512	Performance Characteristics of Light Reconnaissance Car.
E513	Performance Characteristics of G.M. Armoured Car - (Fox I).
E514	6-Ton 4-Wheel G.S. Trailer.
E516	[redacted]ily cleanable Fuel Tank C.M.P.
E517	Dodge 3-Ton Seat Cushions.
E518	Windsor Carrier Comparison Rolling Resistance - Crude [redacted] Synthetic Bog[redacted] Tires.
E519	9Inch Cable Tension M.A.T.
E520	2-Ton Trailer minus Shock Absorbers, 4-Wheel G.S.
E521	Armoured Truck 15 Cwt. [redacted] 4 Exp. Rear Axle Bumpers.
[redacted]	Lock Washers vs. Star Washers - C.M.P. Cab Curtains.
E525	Light Metal Amphibious Truck Body Weights.
E527	Tank Turret Heating.
E529	Performance (Turning Circle and Ditch Crossing Ability) - Windsor Carrier.
E530	Turning Circle of Welsh Guard Carrier.
E531	Brake Drum Seal - Windsor Carrier.
E533	Brake [redacted] [redacted] Excluder - Windsor Carrier.
E534	Operation in Snow of 10.50 [redacted] 20 Parson Oriam, C.B. Super X and D.M.D. Std. Tire Chains.
E535	10 Cwt. Trailer Bolted Body.
E536	Weights - Scout Car Lynx II.
E538	3-Ton Wireless "H" House Type - Data Sheet.
E539	Bimetallic Inserts on [redacted] Shoes of W/C. (U.C.).
E540	Rolling Resistance Study 6x6.
E541	Mud Scrapers for W/C and U/C.
E542	Wider Flange Sprockets on W/C.
E543	[redacted] Weight Study for 15 Cwt. Airportable.
E544	Loading Trials 10 Cwt. Trailer.
E545	3 Ton 12' 5W1 Airportable Body.
E546	3 Ton Wireless T.E.V. - Data Sheet.
E547	3 Ton Wireless "I" House Type - Data Sheet.
E548	3 Ton Cypher Office Body, Data Sheet.
E549	Lubrication of Gun Recoil Slide.
E550	Cab Rear Sill Reinforcement.
E551	P.A.T. Crew Seat Cushions for Drivers in C.M.P. Vehicles.
E552	History of Texas Tire Tests.
E575	Adjustable Superstructure - 3 Ton G.S.
E576	6W1A (Bolted) Transversely Split 3-Ton 12' Airportable Body.
E577	3/4 Ton 4x4 Dodge Airportable G.S. Data Sheet.
E579	8J6 Pilot Commander's Caravan Data Sheet.
E580	[redacted] Cwt. Steel Trailer.
E581	Chev. Connecting Rod Bearings.
E582	20 Cwt. Trailer Drawbar.
E583	Aero-Quip Self Sealing Hydraulic Couplings.
E584	Chain Clearance - Parson "Oriam", C. B. Super-X and D.M.D. Std.
E585	3-Ton Cypher Office Modified - Code #55-D-4 - Data Sheet.
E586	Command L. P. - Body Code #55-D-8, 3-Ton - Data Sheet.
E587	14 Ft. R.E.L. Body (G.S. Type) Mounted - F.W.D. SU-COE.
E588	Light Weight 12' G. S. Body Model C.T. & B. #1 (Tilbury).
E589	C.M.P. Readily Removable Engine Housing - Chevrolet.
E590	Light Weight Tailgate for G.S. Body - 5W1 Data Sheet and Proof of Design Test.
E591	Carter Type Gear Mounted in 15 Cwt. Track - Armoured Ambulance - Design Tests (see E606).
E592	10 Cwt. [redacted]. S. Trailers with Steel Bodies, Type 10E2, Water Proofing Buoyancy and Water Towing Characteristics.
E593	Table of Weights [redacted] K.W. Gen.
E594	Second Type Hoof Hydraulic Safety Valve.
E596	Pilot Model R. E. [redacted] Mk. II Machinery Lorry.
[redacted]	Extended Teeth on Track Sprockets 25 Pdr. S.P. Sexton.
E597	Excessive Wear by Guide Lugs of Sprockets - 25 Pdr. S. P. Sexton.
E598	12 Ft. Light Weight G.S. Body - M.C.I. Ltd.
E599	Trico Windshield Wiper Lubricant (D.N.D. 670).
E601	3-Ton G.S.16 Gauge Tool Box.
E602	Spare Tire Carrier (15 Cwt.).
E603	3-G-1 Ambulance - Sheet Steel Metal Lining.
E604	D. N. D. Drawbar and Tow Hook on Dodge 3/4 Ton 4 x 4.
E606	15 Cwt. Armoured Ambulance, with Carter Type Stretcher Gear - Design Tests (see E606).
E608	15 Cwt. Armoured Ambulance - Weights - Carter Type Stretcher Gear - (see E607).
E607	15 Cwt. Armoured Ambulance with "Carter" Type Stretcher Gear - Proof of Design Tests (Repts. E591, 605, 606 & [redacted]).
E608	Mobile Disinfector on G.M. 6 x 6 Pilot Data Sheet.
E609	Design Test for Stretcher Berths - P.M.A.D. [redacted] for Lindsay Dodge Ambulance Body.
E610	Weights [redacted]' General Service Body for 6 x 6 Chassis.
E611	Heavy Utility Staff Car Role.
E612	Auto Specialties Jack, (4-Ton).
E613	Winch Pull.
E614	Dodge 3/4 Ton G. S. AFT. Narrow Body - Pilot Model Data Sheet.
E615	Reliability [redacted] Stretcher [redacted] Gear - 15 Cwt. Armoured Amb.
E617	Performance Characteristics of Sexton 25 Pdr. S.P. Mount.
E618	Design Test for Stretcher Berths - P.M.A.D. for Lindsay - Dodge - Ford Ambulance.
E619	Lightweight Superstructure.

(b) Prior to [redacted] inception of [redacted] Experimental Section certain Test work was carried out by the Ordnance Proving Ground and the following reports Issued.

[redacted] Tanks.

Defumer for [redacted] Tank Engines.

Canadian Experimental all steel Track.

First Canadian Experimental all steel track. (two reports).

Long distance trials of [redacted] Tank, 73 Octane Fuel with FD Additive.

Comparative Temperatures of Bogie Tires.

Bogie Tire Life Test.

Production test of Synthetic Bogie Tires.

Goodyear Synthetic Tires fitted to Sexton.

Goodyear Synthetic Bogie Tires RAM II.

Track Pin Test on T-16 Universal Carrier.

Canadian Dry Pin Tracks fitted to Sexton.

Comparative Test of Best 20 x [redacted] Synthetic Bogie Tires from U.S. and Canadian Sources.

Canadian Dry Pin Tracks on M-4 Med. Tank.

C.D.P. Tracks and Sprockets on [redacted] Ram II Tank.

13. EXPERIMENTAL REPORTS (CONT'D)

(c) Certain other projects were undertaken prior to the inception of the Experimental Section [redacted] also other projects [redacted] reported apart from the Experimental Series. These [redacted] comprised of the following:-

Report on wheeled vehicles and Universal Carriers - Cold Test trials conducted at Kapuskasing, Ont. - February, 1942.

Report [redacted] A.F.V.'s - Cold Weather Tests - Kapuskasing, Ont., February, 1942.

Report on Cold Weather Tests at Camp Shilo, Manitoba 1942-43. (Part IX of D.N.D. Report).

[redacted] Traversing Trials at Ottawa, Ont. - 1942-43.

Report on [redacted] Barren Lands - (R. J. Kerr observer) February, 1943.

[redacted] Wading Trials - Comox, B. C. - August, 1943.

Experimental Report on Churchill Tank Cold Test - (Capt. A. G. Sangster) - 1942-43.

Report [redacted] Valentine [redacted] - Camp Shilo, Manitoba, 1942-43.

Report on - Investigations of Lead [redacted] lid Type Storage Battery for operation at Low Temperatures.

The making of Scout Car Hulls [redacted] Canada - Report 19, [redacted] Oct. 1942.

Synthetic Bogie Tests conducted at Camp Seeley, California [redacted] Phoenix, Arizona, [redacted] Jan. 18, 1943.

NOTE: Files of these reports at Department of National Defence (Design Group).

14. NATIONAL RESEARCH COUNCIL REPORTS

Certain investigations were carried out [redacted] the National Research Laboratories at the request of the Army Engineering Design Branch. These reports are available from National Research identified [redacted] follows:-

Report No.	Description
MO-408	Anti freeze Compilation of data on physical properties of Ethylene Glycol (Prestone) - Water mixtures.
C886-415	Brake Fluids, Investigation [redacted] Super 9 and Chrysler ISO.
MO-167	Brake Fluids, Investigation Viscosity Chrysler ISO, Delco Super 9 [redacted] oth[redacted]
MK-101	Cooling, Engine of the Ford Scout Car, Investigation to improve.
MK-82	Cooling Investigation on General Motors 8446 Armoured Car.
C412-456	Corrosion, Tests on Brake Assys. (Report [redacted] IV).
C1984-443	Corrosion, Paint for prevention of.
1855-443	Corrosion, Die Cast parts.
C3299-422	Crash Pads for Armoured Vehicles.
[redacted]	Engine, Interim Report Operating Life of 300 Watt Chore Horse [redacted] I, Charging Set Engines on Leaded Gasolines.
MK-126	Engine, Second Interim Report - Operating Life of 300 Watt Chore Horse MK I Charging Set Engines on Leaded Gasolines.
MK-132	Engine, Third Interim Report - Operating Life of 300 Watt Chore Horse MK I Charging Set Engines on Leaded Gasolines.
MK-111	Engine, Ford Mercury, 200 Hour Endurance Test of.
MK-129	Engine, Dodge 250.6 cu.in. displacement, 200 Hour Endurance Test of.
MK-136	Engine, Dodge 250.6 cu.in. displacement, 200 Hour Endurance Test of.

Report No.	Description
C510-418	Fabric, Rubberised, for Blackout Curtains.
818-MK-804	Fungus Tests on Plastic Tips for Webbed Straps, dated 5 Mar. 45.
MF-904	Gasoline, Corrosion Tests [redacted] P.D. additive for.
MF-1342	Gasoline, Lead Content of.
MO-1054	Grease for Trico Windshield Wiper.
16-4-45	Moulding Tests on "ISO-FLEX".
MO-805	Oils, Engine, Pour Point of.
MO-948	Oils and Sludge examination of to determine effect of Ethylene Glycol on engine oils [redacted] related to Seizure of Army Truck Engines.
MO-1180	Oils, [redacted] Content of (Comox Trials).
C1898-428	Paint, Aluminum, Varnish for.
C1384-428	Paint finishes for Wood.
C867-428	Paint, Luminous.
[redacted]	Paint, Heavy Duty Oil effect on.
	Paints, Mines and Resources, Investigation No. 1933 Relation of Paint thickness [redacted] Steel Microstructure to Corrosion Resistance of Painted [redacted]
	Paints, Mines and Resources, Investigation No. 1925 Resistance of Painted Steel to Salt Spray.
C1708-428	Plastic Cups for Water, [redacted] and Gasoline [redacted]
C1634-428	Rifle Clip, Plastic Coated.
[redacted]	Rifle Clip with Plastic Cover.
[redacted]	[redacted] Clip with All-Reclaim Rubber.
C2297-428	Rifle Clip [redacted] with Vinylite.
[redacted]	Rifle Clip covered with Fabric impregnated with Cellulose Acetate.
[redacted]	Rope, Analysis of Hemp and Cotton, Treated and Untreated.
C329-443	Rotproofing Tests on Cotton Thread dated 25 May 1944.
[redacted]	Rotproofing of Thread.
17-137-33	Rotproofing Tests by Australia on Canadian Duck, dated 10 Feb. 45.
C-1897-443	Rotproofing of threads, dated 15, March 1945.
4-C18-9	Rotproofing Rope, dated 13 Mar. 45.
[redacted]	Rust Preventive Oils and Greases and Coatings, Tests on.
C618-407	Seats and Back Rests - Comparison [redacted] Dunlopillo and Airlok for.
[redacted]	Sediment, Analysis of three samples.
8058	Textile Wood Coatings.
[redacted] 783 } [redacted] } - 14-8-45)	Tropicproofing, Tests for Fungus Growth on Electrical Equipment.
17-137-33	Accelerated [redacted]ing of Cotton thread, [redacted] 10 April 1943.

15. COMPANY REPORTS

Investigations were carried out by various individual companies at the request of the Army Engineering Design Branch. Reports were compiled by them [redacted] follows:-

Item	Date	Reported by
Air Cleaner Lab. Tests.	Feb. '45	Ford Motor Co.
Air Cleaner Field Tests.		Ford Motor Co.
Batteries, Curves Low Temperature characteristics DMS-21	Dec. '43	[redacted] Batteries.
Batteries, Tests on DMS-21 at low temperatures.	Aug. '44	Electric Autolite.
Coupling, Flexible, Report No. C-107.		Chrysler Corp.
Cold Test Investigations on CMP vehicles at Oldsmobile Cold Room, Lansing, Mich.	May '42	General Motors.
Cold Test Investigations on Armoured Car [redacted] Oldsmobile Cold Room, Lansing, Mich.	Apr. '42	General Motors.
Cold Tests, Preliminary Report Ford Vehicles at Shilo.	Mar. '43	Ford Motor Company.
Cold Tests on 3 Ton C.M.P.	Jan. '43	General Motors.

15. COMPANY REPORTS (CONT'D)

Item	Date	Reported by
Cold Tests, Final Report Ford Vehicles Shilo.		Ford Company.
Cold Test, Dodge Vehicle Kapuskasing.	Apr.'42	Chrysler Corp.
Cold Tests, Dodge Vehicles in Cold Room.	Mar.'43	Chrysler Corp.
Corrosion, Chrysler Report No.C129, Recommendation for Improvements based on Burma failures.	Sept.'44	
Engine,Dodge 200 hr. Endurance Test at N.R.C.Report #C-130.	Oct.'44	Chrysler Corp.
Heater, Superfex, Low temperature characteristics of.	Aug.'43	Chrysler Corp.
Heater,Motorola Body, Report No.61107.8		Chrysler Corp.
"A" Lorry Machine Shop, Can. built for Russia - Report No.61107.1 - Cold Room Test.		Chrysler Corp.
Lorry O.F.P. Battery Charger,Can.built for Russia - Report No. 61107.2 - Cold Test.		Chrysler Corp.
Lorry O.F.P. Battery Storage Can.built for Russia - Report No. 61107.3 - Cold Room Test.		Chrysler Corp.
Lorry 8 KW - Trailer Can.built for Russia - Report No. 61107.4 - Cold Room Test.		Chrysler Corp.
Lorry 8 - Trailer with Continental Eng. Report No.61107.4-01 - Cold Test.		Chrysler Corp.
Lorry - Electrical Test Repair - Report No. 61107.5 - Cold Room Test.		Chrysler Corp.
Lorry - Artillery Armament Repair - Report No.61107.6 - Cold Room Test.		Chrysler Corp.
Lorry - Maintenance Test and Repair 2-3 - Report No.61107.7 - Cold Room Test.		Chrysler Corp.
Oils,Effect of Diluent on Viscosity and Viscosity Index.	Oct.'42	Imperial Oil Ltd.
Oils, Engine, Dilution of.	Apr.'43	Chrysler Corp.
Performance, Economy and Brake Tests, Report No. 6362 on 15 Cwt. Truck.		General Motors.
Performance, Economy Brake Tests, Report No. 6364 on 6 x 6 Truck.		General Motors.
Performance, Economy and Brake Tests, Report No. 6366 on 3 Ton 4 x 4 Truck.		General Motors.
Performance, Economy and Brake Tests, Report No. 6367 on Heavy Utility Truck.		General Motors.
Transmission, Four Speed Warner Life Tests.	Sept.'43	Chrysler Corp.
Waterproofing, Electrical Equipment Dodge Army Trucks Report No.9315-02.		Chrysler Corp.

16. MAINTENANCE MANUALS, INSTRUCTION BOOKS AND HANDBOOKS

The three major vehicle manufacturers in Canada - Chrysler, Ford and General Motors - prepared, in co-operation with Service Engineering Section of A. E. D. Branch, Instruction Books, Driver's Handbooks and Maintenance Manuals covering vehicle operation, maintenance and repair.

Special Body Vehicles built by Steel Body Manufacturers Association (S.B.M.A.), are covered by a "Maintenance and Spare Parts List", (S.B.Manuals), prepared by Service Engineering Section in co-operation with S.B.M.A. and affiliates.

Special Machinery Lorry built by Chrysler covered by "Parts Instruction Manual" (Mach.), prepared by Service Engineering Section of A.E.D.Branch, in co-operation with Chrysler the various equipment manufacturers.

Drivers Handbooks (British Canadian) were prepared by the Vehicle manufacturers, in co-operation with Service Engineering Section of A. E. D. Branch.

A complete library of the various uals,Instruction Books and Drivers Handbooks is available at D.N.D. Design Group.

17. SERVICE INFORMATION LETTERS - TANKS (S.I.L.) TANKS

Issued to provide Technical and Modification Field Instructions on Canadian Built Tanks.

248 Letters prepared distributed by Service Engineering Section of A.E.D. Branch. The series includes an Index, and is available D.N.D. Design Group.

18. SERVICE INFORMATION LETTERS - GENERAL (S.I.L.) GEN

Issued to provide Technical Information and Data for Field Modifications to users on all "B" vehicles, Snowmobiles, Ronson Lighter, which not covered by Service Information Bulletins prepared by respective vehicle manufacturers.

270 Letters issued by Service Engineering Section, A. E. D. Branch, and included the series index in No. 270.

Central Registry file number was provided for S.I.L.'s.

19. FIELD APPLICATION LETTERS

Issued directive to Users in connection with distribution of vehicle manufacturers Service Information Bulletins.

37 letters were issued, and are filed in 1 volume in D.N.D. Design Group.

20. VEHICLE DEFECT REPORTS (V.D.R.'S)

A record of all product defect reports received by Service Engineering Section of A.E.D.Branch, which were recorded and investigated as necessary,and the report, together with "Corrective Action Taken" distributed to interested users.

308 V.D.R./Tanks, were recorded.
892 V.D.R.'s, other than tanks, recorded.

Any specific recorded report can be quickly located through the card index.

Files, complete with index, available at D.N.D. Design Group.

21. TANK SERVICE REPLACEMENTS (T.S.R.'S)

A directive for preferred procurement and distribution of parts,assemblies or kits for field modification.

5 only T.S.R's were issued,and all were cancelled with the cessation of hostilities; however,material had already been shipped on T.S.R. #3.

T.S.R's carried in Central Registry file 200-2013,with a separate file for each T.S.R.

22.AUTOMOTIVE SERVICE REPLACEMENTS (A.S.R.'S)

A directive for preferred procurement and distribution of parts,assemblies or kits for Field Modifications.

RECORDS (CON'T)

22. AUTOMOTIVE SERVICE REPLACEMENTS (A.S.R.'S) – (CONT'D)

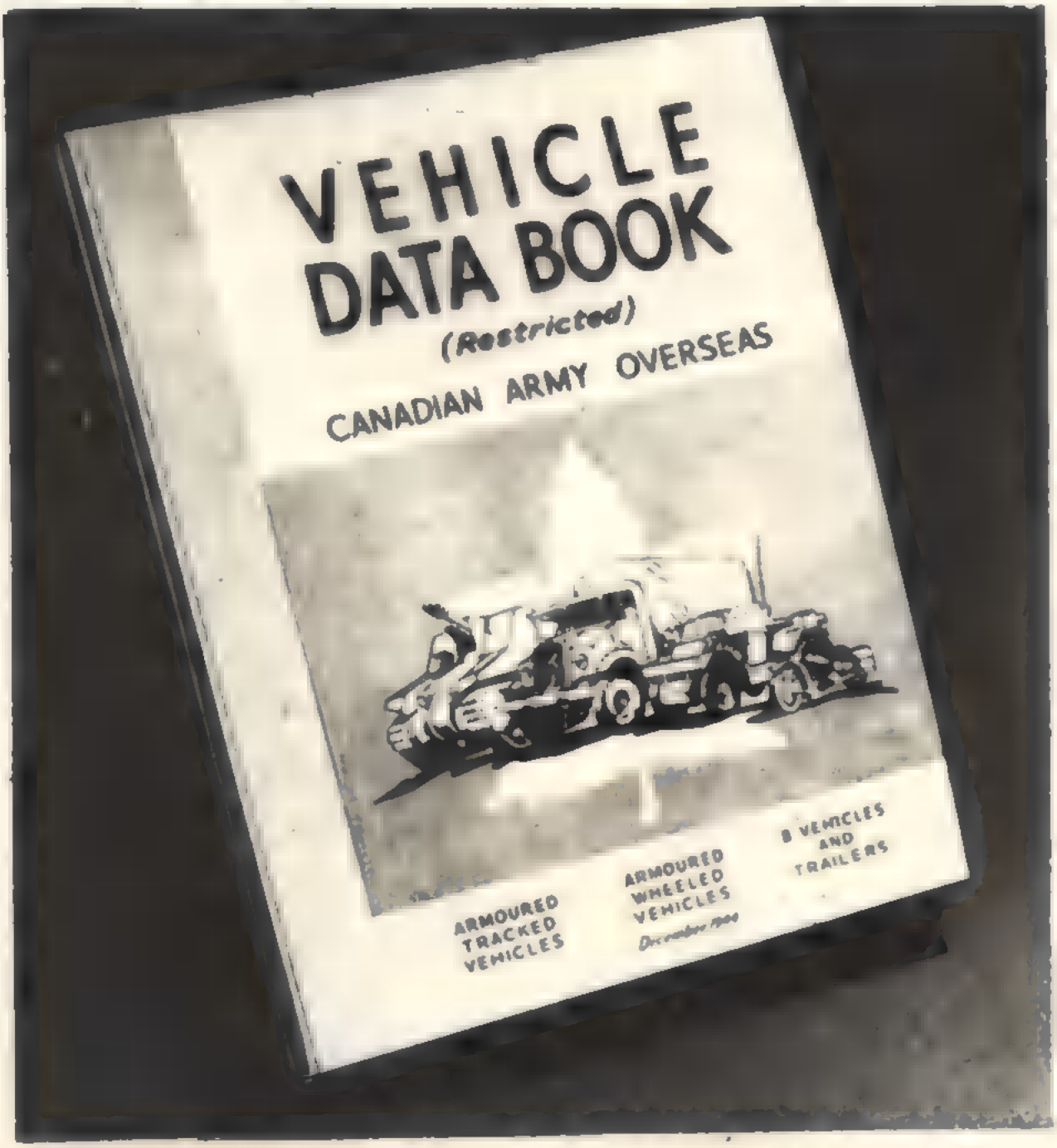
80 A.S.R's have been issued, with one or more to each of thirteen contractors.

They are filed in Central Registry file 73-14, divided into 80 sections - one for each A.S.R.

A complete set of [redacted] A.S.R's (with revisions), bound in 1 Volume is available at D.N.D. Design Group.

23. DEPARTMENT OF MUNITIONS AND SUPPLY CENTRAL REGISTRY FILES.

Reference has been made on individual vehicle data sheets to D. M. & S. file numbers. These files contain correspondence related to the various vehicles and are arranged according to the subject. The file numbers were allocated arbitrarily and a cross-reference list is necessary to determine the applicable file number for any subject. Such a list is on file at Central Registry D. M. & S.



This is a reference hand book covering vehicles held by the Canadian Army Overseas and was prepared under the direction of Canadian Military Headquarters in the U.K.

This publication includes vehicles procured from U.K. and U.S. sources in addition to those produced in Canada. For this reason it describes types of vehicles not included in Data Books prepared by A.E.D.B. It also includes bodies and equipment procured in the U.K. and mounted on Canadian and U.S. produced chassis.

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